3. FACTORS INFLUENCING ENVIRONMENTAL CONDITIONS IN DC

Pollutants and other forms of environmental degradation come from a variety of sources, both from within the District and from far beyond its borders. This section describes factors that influence environmental conditions within DC, including "point" sources (Section 3.1) as well as the more elusive "nonpoint" sources (Section 3.2) such as urban stormwater runoff. Although people often associate pollution with "point sources" (smokestacks reaching into the sky or pipes discharging wastewaters into rivers), other sources may contribute significantly to the overall environmental picture. While these less obvious sources of pollution often go unnoticed, they can be major causes of degradation of the local environment. Described below are some of these factors that impact environmental conditions in DC. As noted in the limitations section (Section 1.4), this analysis is limited to sources within DC, and does not consider the broader regional context.

3.1 POINT SOURCES

Characterization of Point Sources

- Inventories/Lists of Point Sources
- Maps Showing Locations of Point Sources
- Comparison/Relative Ranking of Sources (by Media)

While Washington, DC, is not a heavily industrialized city, more than 1,000 facilities have permitted releases of pollution into the environment. These facilities include power plants, printing operations, Federal Government/military facilities, and many types of small business. These types of pollution sources are referred to as "point sources." This section inventories, characterizes, and "ranks" point sources releasing pollutants to each type of environmental media (water, air, land). Information on these facilities is included, by media, on tables and maps. Also, facilities are compared among themselves with respect to their potential for impacts to human health and the environment. It should be noted that this comparison or ranking of sources for each environmental medium is not a risk assessment. Rather, surrogates of the potential for risk (total volume released, concentration and toxicity of pollutants, etc.) are used where data are available for this purpose. Although there are limitations to these comparisons, they provide a screening-level indication of the relative potential risks of these facilities. This information is intended to be useful for the public and decision makers in the absence of more definitive risk assessments for sources of pollution in DC.

Point sources are stationary facilities that discharge pollutants from smoke stacks, pipes, etc. under permits issued by the Federal and/or local governments. As such, regulations governing these facilities establish limits on the amount and type of emissions. Furthermore, the permits for these point sources specify monitoring requirements to track the emissions. Under the authority of Federal laws such as the Clean Water Act (CWA), the Clean Air Act (CAA), and the Resource Conservation and Recovery Act (RCRA), these facilities obtain permits which specify the conditions for the releases (specific type, amount, and limits for the discharges).

Releases of pollutants from point sources to water, air, or other media are regularly measured to track the emissions of each facility. Data from these monitoring programs are used by DC ERA and EPA for compliance and enforcement purposes. This information is entered into EPA's computer data bases, which are available for analysis of potential impacts to human health and the environment. The computer data bases used in this project to inventory, characterize, and rank point sources within each environmental medium were:

- Permit Compliance System (PCS) - Discharges to Surface Waters;
- Aerometric Information Retrieval System (AIRS) Facility Subsystem (AFS) - Emissions to Air;
- Resource Conservation and Recovery Information System (RCRIS) - Hazardous Waste Generation/Management;
- Comprehensive Environmental, Response, Compensation and Liability Information System (CERCLIS) - Contaminated Sites; and
- Toxic Release Inventory System (TRIS) - Releases of Toxic Substances.

In general, data from the most current year(s) were used in this report. It should be noted, there are limitations to the information contained in these data bases. Although some of the limitations (and caveats) are specifically discussed in the following subsections, several general limitations are worth noting. These data bases do not contain information on all sources, only those facilities that have permits and/or are regulated. Furthermore, monitoring data are generally only provided for larger facilities, inhibiting characterization of smaller facilities that may discharge pollutants from point sources. Also, monitoring data collected from these data bases only cover those pollutants that are specified in permits (or are required to be reported). Therefore, other contaminants could be released that are not addressed in the permits and are not monitored. Furthermore, some information in these data bases pertains to past incidents and may no longer be an indication of current conditions. This is particularly evident in CERCLIS, where sites remain in the data base even after actions have been taken to remedy the situation (Sweeney, 1996).

Comparative ranking of point sources is intended to provide an screening-level indication of the relative potential for environmental impact from the releases from these facilities. In other words, within each environmental medium (e.g., air, water, hazardous wastes), facilities are compared among themselves based on measures of their potential to impact human health and the environment. This comparison is based on "surrogates for risks," usually the amount and type of chemicals involved with the releases from each facility. For example, in comparing facilities emitting to air, it is inferred that a facility with larger releases of more toxic contaminants could result in more degradation to the environment than a facility releasing a smaller amount of a less toxic pollutant. These comparisons do not account for the proximity of potentially-exposed populations or routes of exposure. As such, these comparative/relative rankings should be considered to be approximations and are not absolute risks from these facilities. For more definitive statements about risks from these sources, site-specific monitoring, modeling, and risk assessments would be needed - a monumental effort, taking years and huge sums of money. These surrogates for risks are used as indicators of the potential for the magnitude of impact to human health and the environment.

Why Compare Environmental Risks?

We need to know which environmental problems are the worst. With limited budgets to address environmental protection, it is critical that priorities be set on the problems that are most serious. But, how do we know which problems are deserving of the most attention?

Comparing environmental risks helps to build a scientific foundation for setting environmental priorities.

The approaches used for these analyses are described in each subsection. In general, potential risks/hazards from emissions/discharges were characterized using information on (1) the amount (lbs/yr) of pollution and (2) the hazard (toxicity) of the contaminants present in the releases. Procedures such as these have been used extensively in assessments of wastewater discharges of industrial facilities for EPA's Office of Water (Versar, 1995). For example, discharges of pollutants to surface waters (e.g., Benning Road power plant effluents to the Anacostia River) are quantified using data from the Permit Compliance System (PCS). This assessment used measures such as: the volume (loading in lbs/yr) of wastewater discharged, the loadings of each pollutant (e.g.,

Challenges in Comparing Risks

As long as there are gaps in data, comparing risks will be imperfect. Better tools are needed; until better methodologies are developed to estimate actual exposures to mixtures of pollutants or model toxic responses, conclusions about relative risks will have to be made with caution.

zinc) in the effluent, the environmental fate and toxicity of the types of contaminants released, and toxic weighting factors, to estimate relative impacts of contaminants present in the discharges.

It should be recognized that the lack of data limits the rigor of these analyses. For example, in the case of facilities emitting pollutants to air, monitoring data were available for only the largest facilities. Therefore, these large facilities were compared among themselves. Similarly, for hazardous waste facilities (in RCRIS), data were available on (1) volume of waste managed (generated, received, disposed) (tons/yr) and (2) for the "waste code." From this information, the relative toxicity of the wastes cannot be characterized, and as such, volume of hazardous waste managed was used as the surrogate for this comparison of facilities managing hazardous wastes.

Presented in the following subsections, for each environmental medium/data base, are the inventories of point sources in DC. Versar's approach for obtaining and evaluating these data are described in each subsection. Furthermore, the location of the facilities are displayed on maps (U.S. EPA, 1996b), and comparisons of sources are provided where possible.

Point Sources Inventoried

- Facilities Discharging to Surface Waters
- Air Emitters
- Hazardous Waste Management Facilities
- CERCLIS Sites
- Facilities Releasing Toxic Chemicals

3.1.1 Facilities Discharging to Surface Waters

Thirteen facilities in DC currently have active permits to discharge pollutants into surface waters (Anacostia and Potomac Rivers). These 13 facilities include a publicly-owned treatment works, a water supply facility, electric power generating plants, and others. Table 3-1 presents information on the names, addresses, type of facility, and information about each facility's permit, such as the chemical components specified in its permit. Figure 3-1 displays a map showing the location of facilities discharging to surface waters in the DC area.

Facilities Discharging to Surface Waters

- 13 Active Facilities in DC
- Facilities Include: Wastewater Treatment Plant, Water Supply Facility, Electric Power Generating Plants, etc.

The remainder of this subsection presents an assessment of the pollutant discharges from facilities located within DC to surface waters and potential resulting water quality impacts. Using readily-available data and information sources, annual pollutant loadings from facilities were

Table 3-1. Facilities in DC which have active wastewater discharge permits.

Facility name/ID#	Address	Industrial classification	Major/minor discharge permit/receiving waters	Permit parameters
Washington Aqueduct - Dalecarlia Treatment Plant DC0000019	Washington Aqueduct - Div. 5900 MacArthur Blvd., NW Washington, DC 20315-0220	Water Supply	Major/Potomac River	pH, Residue (Total Non-Filterable), Fe (Total), Al (Total Recoverable) Flowrate
GSA West Heating Plant DC0000035	GSA Washington, GSA NCRHOTP, Rm. 6672, 7th & D Street SW, Washington, DC 20407	Steam & Air Conditioning Supply	Minor/Rock Creek	Temp (°F), pH, Residue (Total Non-Filterable), Oil & Grease & Flowrate
Amerada Hess Washington Terminal DC0000051	Petroleum Bulk Station 1620 South Capitol St., SW Washington, DC 20003	Petroleum Bulk Station & Terminal	Minor/Anacostia River	pH, Oil & Grease & Flowrate
PEPCO - Benning Rd. Facility DC000094	PEPCO 3300 Benning Rd., NE Washington, DC 20019	Electrical Service	Major/Anacostia River	pH, Residue (Non-Filterable), Oil & Grease, Cr (Total), Zn (Total), Cl (Free Available) & Flowrate
National Gallery of Art DC0000167	6th & Constitution Ave., NW Washington, DC 20565	Museums & Art Galleries	Minor/Washington Channel	Temp (°), pH & Flowrate
Super Concrete Corporation DC0000175	5001 Fort Totten Dr., NE Washington, DC 20011	Ready-Mix Concrete	Minor/Anacostia River	Temp (°C), pH, Residue (Total Non-Filterable), Oil & Grease, & Flowrate
Commonwealth of Virginia DOT (Rosslyn Metro) Tunnel, 166 DC0000183	Interstate Maintenance 9280 Bethlehem Rd., Manassas, VA 22110	Regulations Administration of Transportation Programs	Minor/Potomac River & Little River Branch	pH, Residue (Non-Filterable), Oil & Grease N (Total), P (Total), Cr (Total), Cu (Total), Pb (Total), Zn (Total) & Flowrate
DC Materials, Inc. DC0000191	25 Potomac Ave., SE Washington, DC 20003	Ready Mix Concrete	Minor/Anacostia River	pH, Residue (Non-Filterable), Oil & Grease & Flowrate
Goose Bay Aggregates, Inc. DC0000205	2nd St., SW, Washington, DC	Construction Sand and Gravel	Minor/Anacostia River	pH, Residue (Non-Filterable), Oil & Grease & Flowrate

Table 3-1. Facilities in DC which have active wastewater discharge permits. (continued)

Facility name/ID#	Address	Industrial classification	Major/minor discharge permit/receiving waters	Permit parameters
Barney Circle Freeway Modification Project DC0000213	DC Dept. of Public Works, Barry Circle Freeway Mod Proj. 2000 14th St., NW, 5th Floor, Washington, DC 20009	Inspection & Fixed Facility	Minor/Anacostia River	pH, Residue (Non-Filterable), Oil & Grease, Cd (Total), Cr (Total), Cu (Total), Pb (Total), Ag (Total), Zn (Total), and Flowrate
DC Water and Sewer Authority Blue Plains Wastewater Treatment Plant DC0021199	5000 Overlook Ave., SW Washington, DC 20032	Sewerage System	Major/Potomac, Anacostia & Piney Rivers	Temp (°F), Toxicity Conc, Dissolved O_2, pH, Alkalinity (Total), Residue (Total Non-Filterable), N (Total), N (as NH3), Nitrogen, Kjeldhal, N (as Nitrate), N (as Nitrite), P (Total), Hardness, Zn (Total), Flowrate, Cl (Total Residual), Hg (Total), Fecal Coliform, CBOD
PEPCO Buzzard Point Facility DC0022004	1st and V Streets, SW Washington, DC 20004	Electrical Services	Major/Potomac River	Temp (°F), Thermal Discharge, pH, Residue (Total Non-Filterable), Oil & Grease, Sulfate (Total), Cu (Total), Fe (Total), Flowrate & Cl (Total Residual)
JFK Center for Performing Arts DC0000248	New Hampshire Avenue Rock Creek Pkwy, NW Washington, DC	Performing Center (Arts & Entertainment)	Minor/Potomac River	No data available - (New Permit - 1995)

Source: Permit Compliance System (PCS) Database.

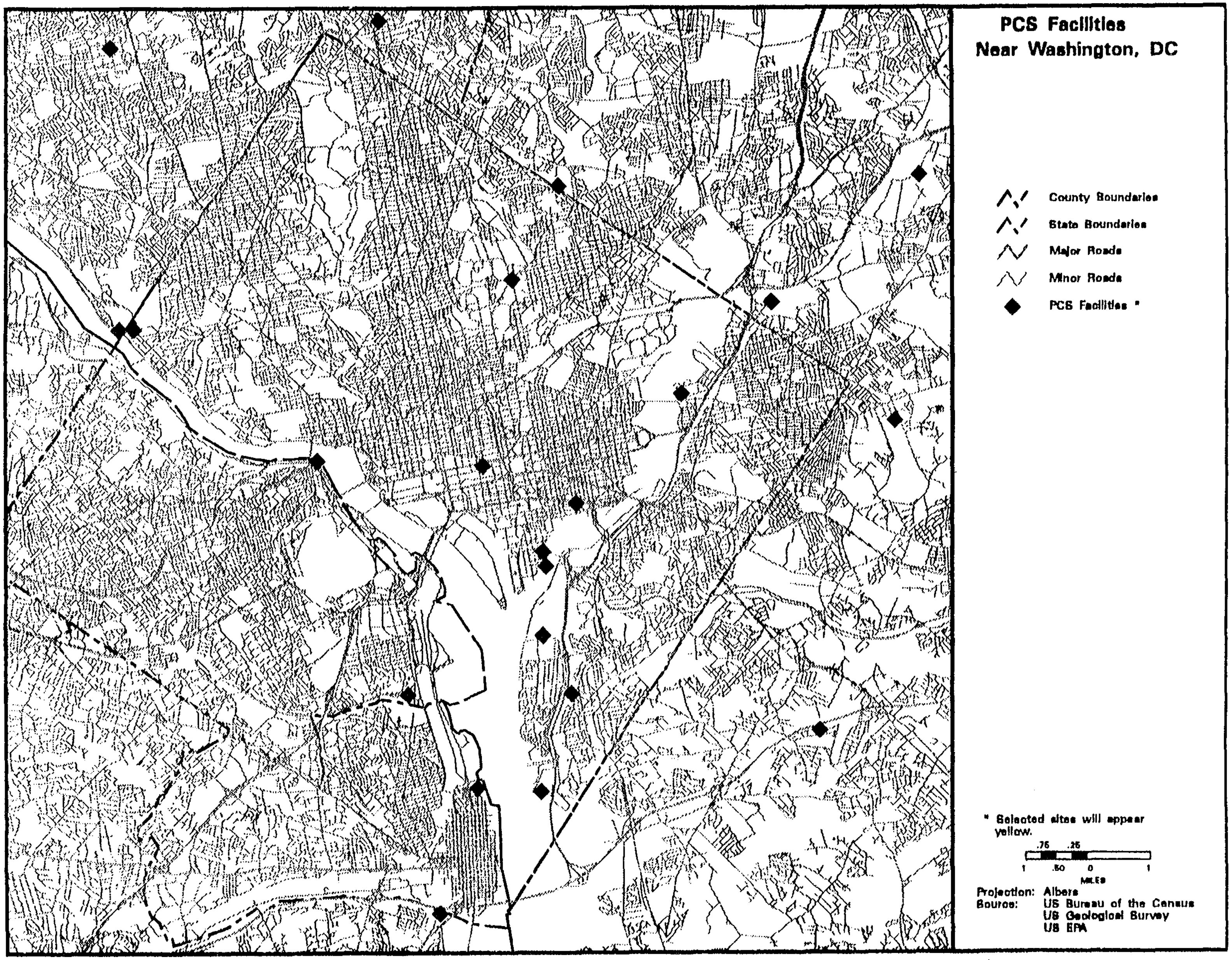

Figure 3-1. Location of facilities discharging to surface waters (PCS facilities) in the Washington, DC area.

estimated, and discharge monitoring data were analyzed. In addition, potential aquatic life and human health impacts were summarized, based on a review of known characteristics of the pollutants identified in the wastewater discharges. The following sections describe the methodology and results (including data sources and assumptions/limitations) used in: (1) the identification and quantification of pollutant releases; and (2) the evaluation of the fate and toxicity of released pollutants.

3.1.1.1 *Identification and Quantification of Pollutant Releases*

Wastewater constituents were identified using the Permit Compliance System (PCS). Discharge monitoring data, if available, were retrieved from PCS for analysis for 12 facilities (one facility received a new permit in 1995, and no data are available on discharges). These facilities include two electric power generating (utility) facilities (power plants), one publicly-owned treatment works (POTW), and a water supply facility with permits classified as "major" based on consideration of effluent flow, physical and chemical characteristics of the wastestream, and location of discharge. Annual pollutant loadings were also generated separately from PCS using an option in PCS called Effluent Data Statistics (EDS). A brief description of the data base, the methodologies used to estimate annual pollutant loads and to determine permit limit excursions (including results), and the assumptions and limitations of the analyses are included below.

(1) Permit Compliance System. PCS is a computerized information management system maintained by EPA's Office of Wastewater Enforcement and Compliance (OWEC). PCS serves as a repository for permit conditions and monitoring, compliance, and enforcement data for facilities regulated by the National Pollutant Discharge Elimination System (NPDES) under the Clean Water Act (CWA).

Among other items, PCS records may contain information that:

- Identifies and describes the facility (including a primary Standard Industrial Classification (SIC) code) to which the permit has been granted;
- Specifies the pollutant discharge limits or monitoring requirements for that facility;
- Records the pollutants measured in the facility's wastewater discharges; and
- Tracks the facility's history of compliance with pollutant limits and reporting requirements.

Facilities with permits classified as "major" must report compliance with NPDES permit limits, usually on a monthly basis, via Discharge Monitoring Reports (DMRs). DMRs provide detailed information on measured concentrations and quantity values, including those that are in violation of established limits for the permit. Because of data entry delays, 1994 is the most complete set of data available at this time. The 13 facilities identified in PCS were the only facilities that had "active" status (several facilities had become "inactive" in the last 2 years) in DC.

(2) Estimation of Annual Pollutant Loads from PCS. Pollutant release data were compiled from 1994 PCS records for those facilities located within the boundaries of DC with available monitoring data. Although PCS is a permit tracking system and not a repository of pollutant release amounts, EDS was used to generate annual loading values (for applicable parameters) at the parameter/discharge pipe level. EDS uses existing PCS reported loading values (quantity measurements), or multiplies reported discharge flows and effluent concentrations to estimate loadings. Loadings were estimated only for records with valid concentration and corresponding flow data.

Results

The results of the estimation of annual pollutant loads from PCS are presented in Table 3-2. Loadings are presented for 12 pollutants (8 conventionals/classicals and 4 toxic pollutants) discharged from 8 facilities (EDS did not estimate loadings for 4 facilities). Total loadings are 159-million lbs/yr of conventional/classical pollutants and 20.3-million lbs/yr of toxic pollutants. Total nonfilterable residue (i.e., total suspended solids (TSS) represents the majority of the estimated classical pollutant loads (approximately 89%), and aluminum represents the majority of the estimated toxic pollutant loads (approximately 64%).

(3) Analysis of PCS Discharge Monitoring Data. In addition to EDS-generated loadings, measured concentration and loading values from monthly monitoring data (i.e., DMR data), if available, were retrieved separately from PCS for 1994. This data set may include data not captured in the EDS loadings analysis. The DMRs provide monitoring requirements, measurement values, limit values, and violation events for each parameter monitored at each outfall. Depending on the monitoring requirements imposed by the permit, measurement values may be reported in many different ways (average, maximum, and minimum concentrations, and/or average and maximum loadings). Only parameters with numeric violations of maximum (or minimum for pH) or average limits were included in the analysis.

Results

Results of the analysis of permit limit excursions are presented in Table 3-3. Data for concentration-based permit limit excursions represent 8 facilities and 404 observations. Average concentration limits were exceeded (i.e., measured observation greater than permit limit) 32 times

Table 3-2. 1994 PCS loading data from Effluent Data Statistics (EDS).

NPDES Number: DC0000019 Facility Name: WASH ADEDUCT-DALECARLIA PLANT

Parameter Number	Pollutant	Load 1994 (lbs/year)	Pollutant Type
01045	Iron, Total	6.97E+06	Toxic
01105	Aluminum, Total Recoverable	1.30E+07	Toxic
00530	Residue, Total Nonfilterable	1.37E+08	Conventional/Classical
	Total Pounds Per Year	1.57E+08	

NPDES Number: DC0000035 Facility Name: GSA WEST HEATING PLANT

Parameter Number	Pollutant	Load 1994 (lbs/year)	Pollutant Type
00530	Residue, Total Nonfilterable	3.97E+02	Conventional/Classical
00556	Oil and Grease	8.56E+02	Conventional/Classical
	Total Pounds Per Year	1.25E+03	

NPDES Number: DC0000094 Facility Name: PEPCO-POTOMAC ELECTRIC CO. (BENNING ROAD)

Parameter Number	Pollutant	Load 1994 (lbs/year)	Pollutant Type
00530	Residue, Total Nonfilterable	2.25E+04	Conventional/Classical
00556	Oil and Grease	5.68E+03	Conventional/Classical
01092	Zinc, Total	4.78E+02	Toxic
50064	Chlorine, Free Available	2.03E+03	Toxic
	Total Pounds Per Year	3.07E+04	

NPDES Number: DC0000175 Facility Name: SUPER CONCRETE CORPORATION

Parameter Number	Pollutant	Load 1994 (lbs/year)	Pollutant Type
00530	Residue, Total Nonfilterable	1.39E+04	Conventional/Classical
00556	Oil and Grease	4.44E+03	Conventional/Classical
	Total Pounds Per Year	1.84E+04	

NPDES Number: DC0000191 Facility Name: DC MATERIALS, INC.

Parameter Number	Pollutant	Load 1994 (lbs/year)	Pollutant Type
00556	Oil and Grease	3.86E+00	Conventional/Classical
00530	Residue, Total Nonfilterable	5.85E+01	Conventional/Classical
	Total Pounds Per Year	6.24E+01	

NPDES Number: DC0000205 Facility Name: GOOSE BAY AGGREGATES, INC.

Parameter Number	Pollutant	Load 1994 (lbs/year)	Pollutant Type
00556	Oil and Grease	1.38E+01	Conventional/Classical
00530	Residue, Total Nonfilterable	1.09E+03	Conventional/Classical
	Total Pounds Per Year	1.11E+03	

Table 3-2. 1994 PCS loading data from Effluent Data Statistics (EDS). (continued)

NPDES Number: DC0021199 Facility Name: D. C. WATER AND SEWER AUTHORITY (BLUE PLAINS)

Parameter Number	Pollutant	Load 1994 (lbs/year)	Pollutant Type
00530	Residue, Total Nonfilterable	4.79E+06	Conventional/Classical
00610	Ammonia (As N)	1.78E+06	Conventional/Classical
00625	Nitrogen, Kjeldhal	2.64E+06	Conventional/Classical
00665	Phosphorus, Total (As P)	1.43E+05	Conventional/Classical
01092	Zinc, Total	3.23E+05	Toxic
50060	Chlorine, Total Residual	5.01E+04	Toxic
71850	Nitrogen (As Nitrate)	9.98E+06	Conventional/Classical
71855	Nitrogen (As Nitrate)	5.72E+05	Conventional/Classical
80082	CBOD	2.16E+06	Conventional/Classical
	Total Pounds Per Year	2.24E+07	

NPDES Number: DC0022004 Facility Name: POTOMAC ELECTRIC POWER CO (BUZZARD POINT)

Parameter Number	Pollutant	Load 1994 (lbs/year)	Pollutant Type
00556	Oil and Grease	1.38E+04	Conventional/Classical
00530	Residue, Total Nonfilterable	1.20E+04	Conventional/Classical
	Total Pounds Per Year	2.58E+04	

Source: PCS (Retrieval Date, March 1996)

Table 3-3. 1994 PCS permit limit excursions.

NPDES Number: DC0000035 Facility Name: GSA WEST HEATING PLANT

Pollutant	Number of Observations (Conc./Load)	Number of Average Load Excursions	Number of Maximum Load Excursions	Number of Minimum Concentration Excursions	Number of Average Concentration Excursions	Number of Maximum Concentration Excursions
Residue, Total Nonfilterable	6/0				1	0
pH	6/0			2		2

NPDES Number: DC0000094 Facility Name: PEPCO-POTOMAC ELECTRIC CO. (BENNING ROAD)

Pollutant	Number of Observations (Conc./Load)	Number of Average Load Excursions	Number of Maximum Load Excursions	Number of Minimum Concentration Excursions	Number of Average Concentration Excursions	Number of Maximum Concentration Excursions
Oil and Grease	35/0				2	3
Zinc, Total	11/0				1	1
Chlorine, Free Available	2/0				0	2

NPDES Number: DC0000167 Facility Name: NATIONAL GALLERY OF ART

Pollutant	Number of Observations (Conc./Load)	Number of Average Load Excursions	Number of Maximum Load Excursions	Number of Minimum Concentration Excursions	Number of Average Concentration Excursions	Number of Maximum Concentration Excursions
pH	10/0			7		7

NPDES Number: DC0000175 Facility Name: SUPER CONCRETE CORPORATION

Pollutant	Number of Observations (Conc./Load)	Number of Average Load Excursions	Number of Maximum Load Excursions	Number of Minimum Concentration Excursions	Number of Average Concentration Excursions	Number of Maximum Concentration Excursions
pH	44/0			1		1
Residue, Total Nonfilterable	44/0				8	4
Oil and Grease	44/0				0	1

NPDES Number: DC0000183 Facility Name: COMMONWEALTH OF VIRGINIA_DOT

Pollutant	Number of Observations (Conc./Load)	Number of Average Load Excursions	Number of Maximum Load Excursions	Number of Minimum Concentration Excursions	Number of Average Concentration Excursions	Number of Maximum Concentration Excursions
Oil and Grease	1/0				0	1
Residue, Total Nonfilterable	1/0				0	1
pH	1/0			0		1

9/19/97

Table 3-3. 1994 PCS permit limit excursions. (continued)

NPDES Number: DC0000205 Facility Name: GOOSE BAY AGGREGATES, INC.

Pollutant	Number of Observations (Conc./Load)	Number of Average Load Excursions	Number of Maximum Load Excursions	Number of Minimum Concentration Excursions	Number of Average Concentration Excursions	Number of Maximum Concentration Excursions
pH	6/0			2		2
Residue, Total Nonfilterable	4/0				2	2

NPDES Number: DC0021199 Facility Name: D. C. WATER AND SEWER AUTHORITY (BLUE PLAINS)

Pollutant	Number of Observations (Conc./Load)	Number of Average Load Excursions	Number of Maximum Load Excursions	Number of Minimum Concentration Excursions	Number of Average Concentration Excursions	Number of Maximum Concentration Excursions
Dissolved Oxygen	15/0			10	12	
Residue, Total Nonfilterable	15/12	2	2		2	2
Nitrogen (As NH3)	12/12	2	2		1	3
Phosphorus, Total	15/12	2	3		2	2
Chlorine, Total Residual	16/0					3
CBOD	15/12	1	1		1	1

NPDES Number: DC00220004 Facility Name: POTOMAC ELECTRIC POWER CO (BUZZARD POINT)

Pollutant	Number of Observations (Conc./Load)	Number of Average Load Excursions	Number of Maximum Load Excursions	Number of Minimum Concentration Excursions	Number of Average Concentration Excursions	Number of Maximum Concentration Excursions
Oil and Grease	48/0				0	1
pH	53/0			3		5

Source: PCS (Retrieval Date, March 1996)

9/25/97

for 7 parameters, including 13 and 12 excursions for total nonfilterable residue and dissolved oxygen, respectively. Forty-five maximum concentration excursions (or minimum for pH) are identified for 8 parameters, including 33 for pH and 9 for total nonfilterable residue. Five facilities have at least one violation based on the average concentration limits, while eight facilities have at least one violation based on the maximum or minimum concentration limits.

Data for load-based permit limit excursions represent 1 facility and 48 observations. The results of the analysis of these data are also summarized in Table 3-3. Average loading limits are exceeded seven times for four parameters (total nonfilterable residue, ammonia, phosphorus, CBOD). Maximum loading limits are exceeded at the same facility for a total of eight excursions.

(4) Assumptions and Limitations. The following assumptions and limitations of these analyses should be noted:

- Only facilities that directly discharge to navigable waters and have a NPDES permit are included in PCS. PCS may not be complete in terms of facilities, pollutants, or wastestreams.

- Only facilities considered as "major" by EPA (i.e., considered to pose the greatest threat to human health or the environment) are required to submit monthly effluent monitoring data to PCS; 8 of the 12 facilities within DC with monitoring data are classified as minor.

- Facilities are not required by their NPDES permit to monitor for all chemicals actually discharged. A facility is only required to report on particular chemicals as specified in the permit conditions.

- EDS is only able to estimate loadings based on the availability and suitability of concentration and flow data. Therefore, the pollutant loading estimates generated in this analysis may underestimate the actual total pollutant loadings.

3.1.1.2 *Fate and Toxicity Evaluation of Released Pollutants*

The environmental fate and toxicity of pollutant releases were evaluated by: (1) compiling physical-chemical and toxicity data for identified pollutants; (2) categorizing the pollutants based on their potential toxicity and environmental fate; and (3) calculating toxic weighting factors based on toxicity and bioaccumulation potential.

The following analyses, in general, do not evaluate impacts associated with releases of all of the conventional/classical pollutants and pollutant parameters because the analyses centered on toxic pollutants. However, the discharge of conventional pollutants such as total nonfilterable residue (i.e., TSS), oil and grease, biological oxygen demand (BOD), nitrogen, alkalinity, and phosphorus can have adverse effects on human health and the environment. For example, habitat degradation can result from increased suspended particulate matter that reduces light penetration and, thus, primary productivity, or from accumulation of sludge particles that alter benthic spawning grounds and feeding habitats. Oil and grease can have a lethal effect on fish by coating surface of gills causing asphyxia, by depleting oxygen levels due to excessive biological oxygen demand, or by reducing stream reaeration because of surface film. Oil and grease can also have detrimental effects on waterfowl by destroying the buoyancy and insulation of their feathers. Bioaccumulation of oil substances can cause human health problems including tainting of fish and bioaccumulation of carcinogenic polycyclic aromatic compounds. High BOD levels can also deplete oxygen levels resulting in mortality or other adverse effects on fish. Nitrogen and phosphorus addition can make surface water susceptible to accelerated eutrophication. Alkalinity or acidity can disrupt or alter the chemical equilibrium necessary to sustain life.

Physical-chemical properties and toxicity data, both measured and estimated, were compiled from EPA ambient water quality criteria documents and various data bases for the pollutants specified in a facilities permit. For some pollutants, neither measured nor estimated data are available for key categorization parameters. As a result, this analysis is an incomplete assessment of potential fate and toxicity of pollutants discharged by DC facilities. The potential fate and toxicity of pollutants associated with DC facilities (i.e., specified in permit), based on chemical-specific data, were examined to place chemicals into qualitative groups based on their potential environmental fate and impact. These groups were based on categorization techniques derived for:

- Acute aquatic toxicity;
- Volatility from water;
- Adsorption to soil/sediment;
- Bioaccumulation potential; and
- Biodegradation potential.

The primary advantage of the categorization methods is that the results allow the user to identify the potential impact/threat of a chemical relative to the potential impact/threat presented by other discharged chemicals. The methods effectively group chemicals based on their potential to harm the environment or humans. The results of this analysis can provide a qualitative indication of potential risk posed by the release of these chemicals. However, these methods are used for screening purposes only, and do not take the place of detailed pollutant assessments that analyze all fate and transport mechanisms. Actual risk depends on the magnitude, frequency, and duration of pollutant discharge loadings; site-specific environmental conditions; proximity and number of human and ecological receptors; and relevant exposure pathways. The acute aquatic toxicity, volatility from water, soil/sediment adsorption, bioconcentration categorization, and biodegradation methods have been reviewed by EPA's Office of Water, Office of Health and Environmental Assessment, and the former Office of Toxic Substances.

Results

The categorization assessment addresses the 20 pollutants identified from the 1994 PCS data. These pollutants include 9 conventionals/classicals and 11 toxics (10 metals and 1 inorganic compound). A pollutant-specific and facility-specific summary of categorization group assignment and human health effect designations is presented in Table 3-4. Approximately 50% of the pollutants (10 of 20) are highly or moderately toxic to aquatic life. About 10% of the pollutants (2 of 20) have a high to moderate potential to volatilize from water. Many of these pollutants, especially metals, are difficult to categorize according to potential adsorption to sediment. Metal partitioning to sediment is more a function of stream chemistry than elemental properties. Approximately 5% of the pollutants (1 of 20) with data are highly or moderately adsorptive to soil/sediment. This pollutant is also highly toxic to aquatic life. One-fifth of the pollutants have a high to moderate bioaccumulation potential. Eight pollutants have been classified as priority pollutants.

This evaluation also identified pollutants that: (1) are known, probable, or possible human carcinogens; (2) are systemic human health toxicants; and (3) have EPA human health drinking water standards (i.e., maximum contaminant levels (MCLs), secondary maximum contaminant levels (SMCLs)). Approximately 70% of the chemicals (14 of 20) have MCLs/SMCLs of which 8 have been identified as human systemic toxicants. EPA classifies three pollutants (cadmium, hexavalent chromium, and lead) as carcinogens.

(1) Toxic Weighting Factor Analysis. EPA's Office of Water uses toxic weighting factors (TWFs) to compare the relative toxicity of industrial effluent discharges. These factors are necessary because different pollutants have different potential effects on human and aquatic life. For example, a pound of mercury in a wastewater stream has a significantly different effect that a pound of iron. Toxic weighting factors for pollutants are derived using ambient water quality criteria and toxicity values. For most pollutants, toxic weighting factors are derived from chronic freshwater aquatic criteria. In cases where a human health criterion has also been established for the consumption of fish, then the sum of both the human and aquatic criteria are used to derive toxic weighting factors. The factors are normalized by relating them to the water quality criteria for copper.

Table 3-4. Categorization summary for pollutants specified in permits.

CAS Number	Parameter Num.	NAME	Aquatic Toxicant	Carcinogen	Systemic	Volatile	Bioaccumulative	Adsorptive	Priority Pollutant	Drinking Water
	00530	Residue, Total Nonfilterable								
	00556	Oil and Grease								
	80082	CBOD								
14797650	71855	Nitrogen (As NO2)								X
14797558	71850	Nitrogen (As NO3)								X
	00625	Nitrogen (Total Kjeldahl)								
7664417	00610, 34726	Ammonia as NH3				X				
7723140	00665	Phosphorus	X							
14808798	00945	Sulfate								X
7440439	01027, 01113	Cadmium	X	X	X		X		X	X
18540299	01032	Chromium hexavalent	X	X	X				X	X
7440473	01034	Chromium			X				X	X
7440508	01042, 01119	Copper	X				X		X	X
7439896	01045	Iron								X
7439921	01051, 01114	Lead	X	X	X				X	X
7440224	01077	Silver	X		X				X	X
7440666	01092, 01094	Zinc	X		X				X	X
7429905	01105	Aluminum	X				X			X
7782505	50060, 50064	Chlorine	X		X					X
7439976	71900, 71901	Mercury	X		X	X	X	X	X	X

NPDES Number	Facility Name	Number of Aquatic Toxicants	Number of Carcinogens	Number of Systemic Toxicants	Number of Volatiles	Number of Bioaccumulative	Number of Adsorptives	Number of Priority Pollutants	Number of Drinking Water Pollutants
DC0000019	Washington Aqueduct-Dalecarlia Plant	1	0	0	0	1	0	0	2
DC0000035	GSA West Heating Plant	0	0	0	0	0	0	0	0
DC0000051	Amerada Hess Washington Terminal	0	0	0	0	0	0	0	0
DC0000094	PEPCO-Potomac Electric Co. (Benning Road)	2	0	3	0	0	0	2	3
DC0000167	National Gallery of Art	0	0	0	0	0	0	0	0
DC0000175	Super Concrete Corporation	0	0	0	0	0	0	0	0
DC0000183	Commonwealth of VA - DOT	4	1	3	0	1	0	4	4
DC0000191	DC Materials, Inc.	0	0	0	0	0	0	0	0
DC0000205	Goose Bay Aggregates, Inc.	0	0	0	0	0	0	0	0
DC0000213	Barney Circle Freeway Modification	5	2	5	0	2	0	6	6
DC0021199	DC Water and Sewer Authority (Blue Plains)	8	3	6	2	3	1	6	10
DC0022004	Potomac Electric Power Co. (Buzzard Point)	2	0	1	0	1	0	1	4

Source: PCS (Retrieval Date, March 1996)

Application to PCS Load Estimates

TWFs were applied to the PCS load estimates generated by EDS to calculate the toxic weighted load. For each pollutant, the TWF, if available, is multiplied by the loading to estimate toxic-pound equivalents. These toxic weighted loads provide a measure for comparison between pollutants and facilities based on the toxicity of contributing pollutants. Table 3-5 provides a summary of the total weighted 1994 PCS annual loads on a pollutant and facility basis. Based on TWFs, approximately 90% of the weighted surface water releases are from aluminum. While there are no data to suggest that aluminum is acutely toxic to humans, certain subpopulations (Alzheimers' patients and persons with chronic kidney disease) may be effected (ATSDR, 1991). Aluminum, however, is toxic to aquatic life and plants. Brook trout and stripped bass are particularly sensitive and freshwater acute aquatic toxicity limits for aluminum are 748 μg/l (ATSDR, 1991).

3.1.1.3 *Comparison of Facilities Discharging to Surface Waters*

Results from the analyses presented above were used to as the basis to compare potential impacts of the 12 facilities in DC that discharge to surface waters. Four different comparisons were possible, based on: (1) total loadings (lbs/yr), (2) permit limit excursions, (3) type (fate/toxicity) of pollutants discharged, and (4) toxic-weighted loads. It should be noted, again, that these comparisons are approximations and should not be considered definitive because of the lack of detailed data. The toxic-weighted load method is the preferred approach, because it accounts for both the amount and toxicity of pollutants discharged. However, only four facilities had data available (based on parameters included in the permit and monitoring data) for this approach. This approach indicates that the Dalecarlia Treatment Plant, Blue Plains Wastewater Treatment Plant, and PEPCO-Benning Road are the facilities with the loadings of greatest potential impact (based on toxic-weighted/loadings). Evaluation cannot be made using this approach about the other eight facilities.

Comparisons based on the other three approaches support the inference that Blue Plains and Dalecarlia Treatment Plants are among the facilities that have the greater potential to pose risks to human health and the environment. For example, based on total loadings (lbs/yr) of all pollutants monitored, Dalecarlia and Blue Plains discharged 1.57×10^8 and 2.24×10^7 lbs/yr, respectively. Most of the other facilities' discharges are substantially lower (in order): PEPCO Benning Road (3.07×10^4 lbs/yr), PEPCO Buzzard Point (2.58×10^4 lbs/yr), Super Concrete (1.84×10^4 lbs/yr), GSA West Heating Plant (1.25×10^3 lbs/yr), Goose Bay Aggregates (1.11×10^3 lbs/yr), and DC Materials (6.24×10^1 lbs/yr). Examination of permit limit excursions also indicates that Blue Plains is among the facilities with a higher number of permit violations. Other facilities having a higher number of violations indicate that PEPCO Benning Road, National Gallery of Art, PEPCO Buzzard

Table 3-5. 1994 PCS annual loads using toxic weighting factors.

NPDES Number: DC0000019 Facility Name: WASH ADEDUCT-DALECARLIA PLANT

Parameter Number	Pollutant	Load 1994 (lbs/year)	Toxic Weighting Factor	Toxic Pound Equivalent
01045	Iron, Total	6.97E+06	5.60E+03	3.90E+04
01105	Aluminum, Total Recoverable	1.30E+07	6.40E+02	8.30E+05
00530	Residue, Total Nonfilterable	1.37E+08		
	Total Pounds Per Year	1.57E+08		8.69E+05

NPDES Number: DC0000035 Facility Name: GSA WEST HEATING PLANT

Parameter Number	Pollutant	Load 1994 (lbs/year)	Toxic Weighting Factor	Toxic Pound Equivalent
00530	Residue, Total Nonfilterable	3.97E+02		
00556	Oil and Grease	8.56E+02		
	Total Pounds Per Year	1.25E+03		

NPDES Number: DC0000094 Facility Name: PEPCO-POTOMAC ELECTRIC CO. (BENNING ROAD)

Parameter Number	Pollutant	Load 1994 (lbs/year)	Toxic Weighting Factor	Toxic Pound Equivalent
00530	Residue, Total Nonfilterable	2.25E+04		
00556	Oil and Grease	5.68E+03		
01092	Zinc, Total	4.78E+02	5.10E+02	2.44E+01
50064	Chlorine, Free Available	2.03E+03	4.90E+01	9.94E+02
	Total Pounds Per Year	3.07E+04		1.02E+03

NPDES Number: DC0000175 Facility Name: SUPER CONCRETE CORPORATION

Parameter Number	Pollutant	Load 1994 (lbs/year)	Toxic Weighting Factor	Toxic Pound Equivalent
00530	Residue, Total Nonfilterable	1.39E+04		
00556	Oil and Grease	4.44E+03		
	Total Pounds Per Year	1.84E+04		

NPDES Number: DC0000191 Facility Name: DC MATERIALS, INC.

Parameter Number	Pollutant	Load 1994 (lbs/year)	Toxic Weighting Factor	Toxic Pound Equivalent
00556	Oil and Grease	3.86E+00		
00530	Residue, Total Nonfilterable	5.85E+01		
	Total Pounds Per Year	6.24E+01		

NPDES Number: DC0000205 Facility Name: GOOSE BAY AGGREGATES, INC.

Parameter Number	Pollutant	Load 1994 (lbs/year)	Toxic Weighting Factor	Toxic Pound Equivalent
00556	Oil and Grease	1.38E+01		
00530	Residue, Total Nonfilterable	1.09E+03		
	Total Pounds Per Year	1.11E+03		

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Table 3-5. 1994 PCS annual loads using toxic weighting factors. (continued)

NPDES Number: DC0021199 Facility Name: D. C. WATER AND SEWER AUTHORITY (BLUE PLAINS)

Parameter Number	Pollutant	Load 1994 (lbs/year)	Toxic Weighting Factor	Toxic Pound Equivalent
00530	Residue, Total Nonfilterable	4.79E+06		
00610	Ammonia (As N)	1.78E+06	4.50E+03	8.01E+03
00625	Nitrogen, Kjeldhal	2.64E+06		
00665	Phosphorus, Total (As P)	1.43E+05		
01092	Zinc, Total	3.23E+05	5.10E+02	1.65E+04
50060	Chlorine, Total Residual	5.01E+04	4.90E+01	2.46E+04
71850	Nitrogen (As Nitrate)	9.98E+06		
71855	Nitrogen (As Nitrite)	5.72E+05		
80082	CBOD	2.16E+06		
	Total Pounds Per Year	2.24E+07		4.91E+04

NPDES Number: DC0022004 Facility Name: POTOMAC ELECTRIC POWER CO (BUZZARD POINT)

Parameter Number	Pollutant	Load 1994 (lbs/year)	Toxic Weighting Factor	Toxic Pound Equivalent
00556	Oil and Grease	1.38E+04		
00530	Residue, Total Nonfilterable	1.20E+04		
	Total Pounds Per Year	2.58E+04		

Source: PCS (Retrieval Date, March 1996)

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Point, and Super Concrete Corporation. Finally, review of the types of pollutants discharged and their physical/chemical/toxic properties indicates that Blue Plains is one of the facilities with the higher number of potentially-harmful pollutants. Also, it has been estimated that Blue Plains contributes 95% of the nitrogen and 53% of the phosphorous loadings from DC (Chesapeake Research Consortium, 1995).

3.1.2 Air Emitters in DC

Air Emitters

- 267 Facilities in DC
- 11 Major Sources - Power Plants, Hospitals, Printing Operations
- 256 Smaller Sources -- Cleaners, Hotels, etc.

In 1994, 267 facilities in Washington DC (AIRS Data Base retrieval on March 29, 1996) have air emission permits and/or are regulated under the CAA. Of these 267 facilities, monitoring data are available for the 11 largest facilities, including hospitals, universities, utility companies, heating/cooling systems using boilers, and government printing and publishing operations. The remaining facilities (256) are smaller sources and no air monitoring data were presented in the AIRS Facility Subsystem (AFS), because they do not exceed the reporting threshold. These smaller facilities include hotels, dry cleaners, property management companies, parking lots, and government maintenance centers (Table A-1 in Appendix A). While emissions from these smaller facilities may collectively contribute to air pollution, data were not available to characterize the emissions from each.

Monitoring data are available for regulated air pollutants emitted from stationary point sources (smokestacks/pipes). EPA's AIRS is the national repository for information about airborne pollution in the United States. In general data are available on criteria air pollutants such as particulates, carbon monoxide, sulfur dioxide, etc. Data were extracted from AFS which has emissions and compliance data on air pollution point sources tracked by EPA and State/local environmental regulatory agencies. As such, the data collected only accounted for the permitted emissions from stationary sources (stacks) and do not address fugitive emissions or other releases to air from mobile sources. The 11 facilities for which emissions data were available from AIRS/AFS are presented in Table 3-6, and locations of air emitters in the region are shown on Figure 3-2. This table also presents addresses, general industrial categories, and emission data (in lbs/yr) for the five criteria air pollutants: total suspended particulates (TSP), carbon monoxide (CO), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), and volatile organic compounds (VOCs). From the

Table 3-6. Facilities with air permits in D.C. and emissions data.

Facility name/ ID#	Address	Emissions (lbs/yr)		No. of point sources monitoring	SIC industrial classification
Capitol Power Plant DC8470000003	New Jersey Avenue & E St., SE Washington, DC 20515	TSP	40,848	2	Steam & Air Condit. Supply
		CO	159,215	3	
		SO_2	160,427	4	
		NO_2	796,765	4	
		VOC	5,419	4	
Georgetown University Power Plant DCD049515844	37th & O St., NW Washington, DC 20057	TSP	5,030	5	Professional School (one fossil fuel-fired steam generator)
		CO	16,240	4	
		SO_2	70,210	5	
		NO_2	238,445	5	
		VOC	2,381	5	
GSA Central Heating Plant DC0470000001	13th & C Street, SW Washington, DC 20407	TSP	2,929	6	Heating & Air Conditiong
		CO	49,485	5	
		SO_2	167,722	5	
		NO_2	559,104	7	
		VOC	2,822	7	

Table 3-6. Facilities with air permits in D.C. and emissions data. (continued)

Facility name/ ID#	Address	Emissions (lbs/yr)		No. of point sources monitoring	SIC industrial classification
GSA West Heating Plant DC947000002	1051 29th St., NW Washington, DC 20407	TSP	16,147	5	Heating & Air Conditioning
		CO	58,857	5	
		SO_2	324,945	8	
		NO_2	258,261	8	
		VOC	6,695	5	
Howard University DC0983969668	2240 6th St., NW Washington, DC 20059	TSP	7,490	2	Professional School (four fossil-fueled boilers for heating)
		CO	5,350	2	
		SO_2	157,290	2	
		NO_2	24,150	3	
		VOC	364	2	
PEPCO - Benning Road Generating Station DC00081951	3300 Benning Rd., NE Washington, DC 20019	TSP	123,346	8	Electrical Services
		CO	90,390	8	
		SO_2	1,464,964	8	
		NO_2	1,053,187	8	
		VOC	11,825	8	

Table 3-6. Facilities with air permits in D.C. and emissions data. (continued)

Facility name/ ID#	Address	Emissions (lbs/yr)		No. of point sources monitoring	SIC industrial classification
PEPCO - Buzzard Point Generating Station No ID# not reported	1st & V St., SW Washington, DC 20004	TSP	3,485	2	Electrical Services
		CO	10,734	2	
		SO_2	76,112	2	
		NO_2	47,256	2	
		VOC	3,325	2	
St. Elizabeth's Hospital DC9751305997	2700 Martin Luther King Dr. SE, Washington, DC 20013	TSP	33,957	2	Hospital
		CO	24,255	2	
		SO_2	713,097	2	
		NO_2	97,020	2	
		VOC	1,649	2	
U.S. Bureau of Engraving & Printing DC2200907812	14th & C St., SW Washington, DC 20228	TSP	NR	NR	Commercial Printing
		CO	NR	NR	
		SO_2	NR	NR	
		NO_2	NR	NR	
		VOC	251,760	NR	

Table 3-6. Facilities with air permits in D.C. and emissions data. (continued)

Facility name/ ID#	Address	Emissions (lbs/yr)		No. of point sources monitoring	SIC industrial classification
U.S. Government Printing Office DC4040005031	45 G St., NW Washington, DC 20401	TSP	NR	NR	
		CO	NR	NR	
		SO_2	NR	NR	
		NO_2	NR	NR	
		VOC	145,442	NR	
U.S. Soldiers and Airmen's Home DC8210021160	3700 N. Capital St., NW Washington, DC 20317	TSP	20,220	1	Nursing & Personal Care Facility
		CO	8,510	1	
		SO_2	267,238	1	
		NO_2	93,610	1	
		VOC	1,923	1	

NR = not reported.

Source: AIRS/AFS Database, 1996.

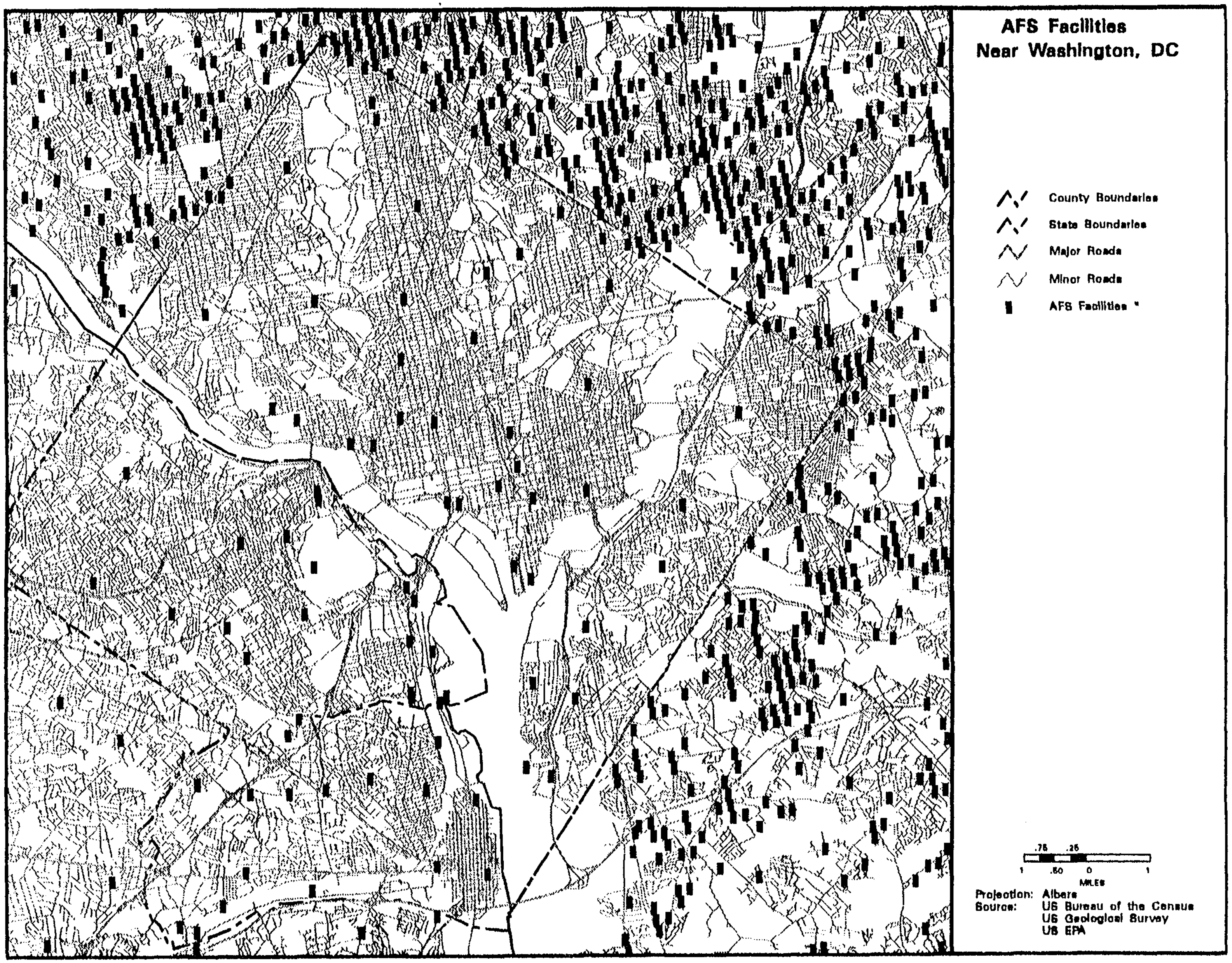

Figure 3-2. Location of facilities with air emissions (AIRS-AFS facilities) in the Washington, DC area.

11 point sources, more than 250,000 lbs. of particulates, 400,000 lbs. of CO, 3.4 million lbs. of SO_2, 3.1 million lbs. of NO_2, and 400,000 lbs. of VOCs were emitted annually.

A system was developed to compare the 11 facilities in DC based on the mass of pollutants emitted and the potential for risks to human health and the environment. While an established environmental assessment approach has been developed to evaluate risks from discharges to surface waters, no similar approach could be identified for air emissions. Therefore, several different approaches were considered based on the total mass (lbs/yr) of emissions and the pollutants of concern. This ranking used emissions data from AFS on the five criteria pollutants regularly monitored (TSP, CO, SO_2, NO_2, and VOCs). These ranking approaches were:

- Ranking by Total Mass of Emissions (Sum of Five Parameters);
- Ranking by All Five Parameters Individually;
- Ranking by Each of the Five Individual Parameters separately; and
- Ranking by Toxic Weighting Factors.

This toxic weighting factor approach was developed considering the relative hazards of the individual pollutants using two standards (i.e., National Ambient Air Quality Standards (NAAQS) and Time Weighted Averages (TWA) adopted value by the American Conference of Government and Industrial Hygienists (ACGIH)). CO, NO_2, and SO_2 had both NAAQS and TWA standards; therefore, the concentration limits of each of these three pollutants were normalized to produce toxic weighting factors for these air pollutants (e.g., 0.03 ppm for SO_2/0.05 ppm for NO_2 = 0.6). The emissions of each parameter (lbs/yr) from the facilities were multiplied by these weighting factors to produce a total emissions equivalency. The total of the three parameter concentrations was used as a candidate approach for comparing the facilities.

Based on the examination of the eight different ranking schemes (Table 3-7), only a limited differentiation among facilities was evident. However, the larger emitters were fairly apparent, especially with respect to total mass of NO_2 and SO_2. Taking into consideration all ranking schemes, the 11 facilities were placed along a continuum from higher to lower emitters (presented in Table 3-8). While two of the facilities (U.S. Government Printing Office and U.S. Bureau of Engraving and Printing) had no monitoring data for TSP, CO, NO_2, and SO_2 (and as a result were relatively low on most of the ranking schemes), they have very large volatile organic compound (VOC) emissions. As such, these larger emitters of VOCs may contribute to an existing ozone

Table 3-7. Approaches considered for ranking facilities with air emissions in DC.

Facility	Ranking by total emissions (sum of 5 parameters)	Ranking by all 5 parameters individually	Ranking by NO_2	Ranking by VOCs	Ranking by SO_2	Ranking by CO	Ranking by TSP	Ranking by toxic weighting factors*
Capital Power Plant	2	2	2	5	6	1	2	8
Georgetown University	6	7	5	8	9	6	7	8
GSA Central Heating Plant	3	5	3	7	5	4	8	4
GSA West Heating Plant	4	3	4	4	4	3	5	5
Howard University	8	9	9	11	7	9	6	7
PEPCO-Benning Road	1	1	1	3	1	2	1	1
PEPCO-Buzzard Point	11	8	8	6	8	7	9	9
St. Elizabeth's Hospital	3	4	6	10	2	5	3	2
U.S. Bureau of Engraving & Printing	7	--	--	1	--	--	--	--
U.S. Government Printing Office	10	--	--	2	--	--	--	--
U.S. Soldiers & Airmen's Home	4	6	7	9	3	8	4	6

* Based on NAAQS Standards and TWAs for the criteria air pollutants.

Table 3-8. Comparison of facilities with air emissions.

Facility	Comparative ranking
PEPCO-Buzzard Point	Higher
PEPCO-Benning Road	↑
Capital Power Plant	
U.S. Government Printing Office	
U.S. Bureau of Engraving & Printing[a]	
St. Elizabeth's Hospital[a]	
U.S. Soldiers & Airmen's Home	
Howard University	
GSA West Heating Plant	
GSA Central Heating Plant	↓
Georgetown University	Lower

[a] Because VOCs contribute to the elevated ozone concentration in the District, and the amounts emitted from the two facilities were substantially higher than from other facilities, the two printing facilities were placed higher in this comparative ranking.

problem in the DC area. Because of this concern, these two facilities were moved toward the higher end of the scale.

3.1.3 Hazardous Waste Management Facilities

Hazardous Waste Facilities

- 939 Facilities in RCRIS
- 15 Large Quantity Generators - power plants, printing facilities, transit authorities, government organizations
- 924 Small Quantity Generators - automobile service stations (body shops, paint shops), cleaners, medical offices, etc.

In Washington, DC, 939 facilities were listed in RCRIS as generators/ managers of hazardous waste (RCRIS retrieval on March 24, 1996, according to 1993 data). More than 620 tons of hazardous wastes were managed by 15 large quantity generators (LQGs). These 15 LQG facilities are listed in Table 3-9 (along with the mass (in tons/yr) and types of wastes handled), and their locations are included on Figure 3-3. These facilities include power plants, printing facilities, transit authorities, and government establishments. When a facility generates/manages a higher mass of hazardous waste, there may be a greater potential for risks to human health and the environment (i.e., the mass of hazardous waste is considered a surrogate for potential risk in this analysis). These large facilities were considered to be more likely to have the potential to pose greater risks than individual small quantity generators (SQGs). However, taken collectively, the SQGs generate as much hazardous waste as the 15 larger facilities (Seeeney, 1996).

Data on hazardous waste management are available from EPA's RCRIS data base. Under the Resource Conservation and Recovery Act (RCRA), hazardous wastes are regulated from generation until they are disposed ("cradle-to-grave"). RCRIS tracks information related to all phases of hazardous waste management (facilities, permits, generation, disposal, etc.). Searches of RCRIS were used to obtain information on the volume and type of wastes managed by facilities in Washington, DC. Data were retrieved and analyzed to characterize the volume and toxicity/hazard of wastes handled by each facility. However, the data on the type of waste (the waste code) reveal only limited information about the toxic properties of the wastes. Some waste codes indicate if the wastes are ignitable, corrosive, reactive, or toxic, while others only indicate the type of industrial process that generates them (with no information about concentrations of specific pollutants). As a result, the mass (tons/yr) was examined as the sole indicator of potential risk from facilities managing hazardous wastes.

The 15 LQGs were ranked by the total mass of all hazardous waste(s) managed (generated, received, and disposed) by each facility, in descending order, to illustrate the relative potential risks

Table 3-9. Hazardous waste management facilities (large quantity) in Washington, D.C.

Facility name	Address	EPA ID number	Quantity managed (tons)	Type of waste(s)
PEPCO-Benning Road Generating Station	3300 Benning Road, NE	DCD000819516	220.45	ICRT[a], spent solvents, discarded CCP[b]
U.S. Bureau of Engraving and Printing	14th and C Streets, SW	DC2200907812	134.58	lab pack, ICRT, spent cyanide, WW tmnt sludge, solv wash
Washington Metro Area Transit Authority	2250 26th Street, NE	DCD980555643	69.01	ignitable, corrosive, spent solvent, toxic
W M A T A	601 T Street, NE	DCD981737422	40.24	ignitable, corrosive, spent solvent, toxic
Bolling Air Force Base	Portland Street, SW	DC9570090036	27.72	ICRT, spent solvents, discarded CCP
Washington Gas & Light Company	1200 N Street, SE	DCD077797793	23.95	ignitable, toxic
Food and Drug Administration FB 8	200 C Street, SW HFS.657	DC8470000086	21.51	ICRT, spent solvents, discarded CCP, production wastes
Washington Post Newspaper	1150 15th Street, NW	DCD003245768	19.38	ignitable, corrosive, spent solvent
Walter Reed Army Medical Center	6825 16th Street, NW	DC4210021156	17.36	ICRT, spent solvents, discarded CCP
Architect of the Capitol	Capitol Hill	DC4141707162	16.54	ignitable, corrosive, spent solvent, toxic, discarded CCP
U.S. Government Printing Office	45 G St., NW	DC4040005031	15.78	ignitable, corrosive, spent solvent, toxic
Naval Research Laboratory	4555 Overlook Ave., SW	DC8170024311	14.70	ICRT, spent solvents, discarded CCP
Washington Post Newspaper, Southeast Pl.	225 Virginia Avenue, SE	DCD003238193	14.22	ignitable
Naval District - Washington, DC	901 M Street, SE	DC9170024310	2.92	ignitable, corrosive, spent solvent, toxic
Catholic University of America	620 Michigan Avenue, NE	DCD980204879	2.88	lab packs, ICRT, spent solvents, discarded CCP
		total:	641.24	

[a] ICRT = ignitable, corrosive, reactive, toxic
[b] CCP = commercial chemical products

Source: RCRIS Data Base search, March 24, 1996

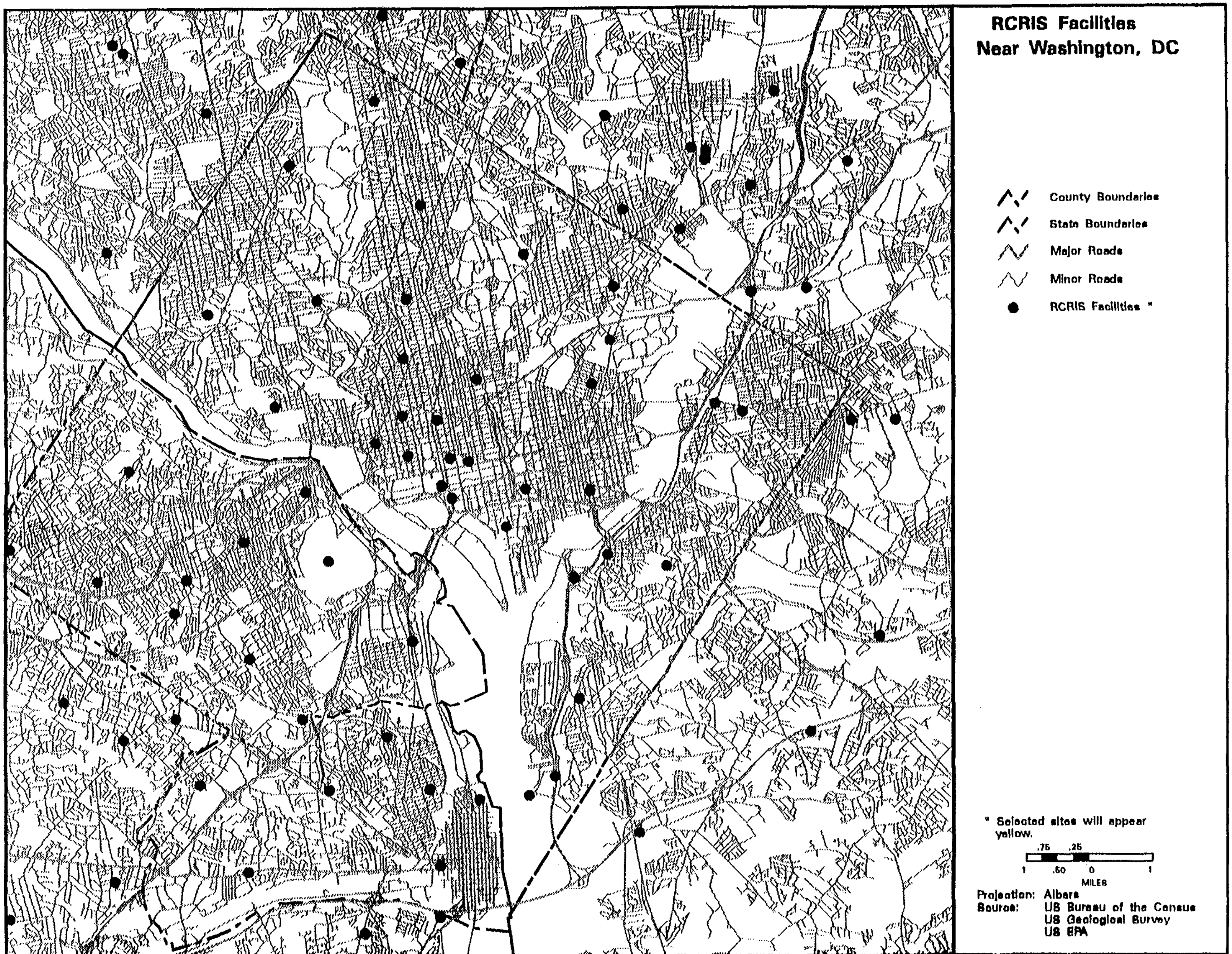

Figure 3-3. Location of hazardous waste management (RCRIS) facilities in the Washington, DC area.

associated with these facilities (Table 3-9). Those facilities listed at the top of the table managed larger amounts of hazardous wastes, and are considered, therefore, to represent a potentially greater risk than the facilities that are listed toward the bottom of the table.

The other 924 facilities, classified as SQGs, are listed in Table A-2 in Appendix A. Of these smaller facilities, only about 600 were active generators (Sweeney, 1996). These facilities include Federal Government offices, gas/service stations, schools, doctor and dentist offices, dry cleaners, public transit stations, printing companies, and other similar types of small businesses. A facility is classified as an SQG if it generates in one calendar month: (1) less than 1,000 kilograms of a hazardous waste; (2) less than 1 kilogram of an acutely hazardous waste; or (3) less than 100 kilograms of any residue or contaminated soil, waste, or other debris resulting from the cleanup of a spill of an acutely hazardous waste. Also, the SQG status applies to any generator that accumulates less than the amounts listed in (2) and (3) above of an acutely hazardous waste on site at any one time. Due to the lack of data on SQGs, a detailed characterization of the nature and volume of the wastes managed at these facilities was not feasible.

3.1.4 CERCLIS Sites

The CERCLIS data base lists 32 sites in Washington, DC (Table 3-10). When a hazardous waste site is discovered (e.g., drums), information about the site is entered into CERCLIS. Information regarding the sites in DC that appear in CERCLIS was extracted from the EPA home page on the Internet [EPA Home\Superfund Home\OERR Home; maintained by the U.S. Environmental Protection Agency, Office of Emergency and Remedial Response; Revised March 25, 1996.] The sites in CERCLIS are investigated to determine what further actions (if any) are necessary to protect human health and the environment. None of the sites were listed on the National Priorities List (NPL) as "Superfund sites" (i.e., none were determined to be harmful enough to be identified as EPA priorities); however, recently the Washington Navy Yard was proposed by the EPA to be included on the NPL. One site (Fort Lincoln) was on the interim priority list, but was later removed. However, when a site is included in CERCLIS, it remains in the data base even after actions have been taken (e.g., removal of drums) to remedy the problem (Sweeney, 1996). As such, many of the sites listed have no ongoing activities.

CERCLIS Sites

- 32 Sites in Data Base
- No Sites on National Priorities List
- Washington Navy Yard Recently Proposed by EPA as NPL Site

Table 3-10. CERCLIS sites in the District of Columbia.

Site Name: U.S. BUREAU OF PRINTING AND ENGRAVING
Street: 14TH AND C STs., SW
City: WASHINGTON State: DC Zip: 20228
EPA ID: DCD146729389

Site Name: CUSTOM'S FIELD OFFICE
Street: 1200 PENNA AVE
City: WASHINGTON State: DC Zip: 20004
EPA ID: DC5470090015

Site Name: HUBERT H. HUMPHREY BUILDING
Street: 200 INDEPENDENCE AVE., S.W.
City: WASHINGTON State: DC Zip: 20201
EPA ID: DC6470000104

Site Name: JAMES T WARRING & SONS INC
Street: 1321 S CAPITOL ST
City: WASHINGTON State: DC Zip: 20003
EPA ID: DCD042278994

Site Name: SOLDIERS AND AIRMEN'S HOME
Street: MICHIGAN AVE, N.E.
City: WASHINGTON State: DC Zip: 20317
EPA ID: DC6170090025

Site Name: WASHINGTON OFFICE (GSA)
Street: 2ND AND M ST., SW
City: WASHINGTON State: DC Zip: 20408
EPA ID: DC8470090004

Site Name: WASHINGTON PLATING
Street: 2119 14TH ST NW
City: WASHINGTON State: DC Zip: 20009
EPA ID: DCD047277801

Site Name: NEW POST OFFICE
Street: 1200 PENNSYLVANIA AVE. NW
City: WASHINGTON DC State: DC Zip: 20004
EPA ID: DCD983966433

Table 3-10. CERCLIS sites in the District of Columbia. (continued)

Site Name: ANACOSTIA DRUM SITE
Street: 11TH STREET BRIDGE & GOOD HOPE ROAD
City: WASHINGTON State: DC Zip: 20020
EPA ID: DCD983967662
Site Description: OSC called to assess two drums, 3/4 full of unknown material on park police property. Drums markings identified "DOT". Drum #1 contained soil, drum #2 contained mud- 3-6" water over mud.

Site Name: ANACOSTIA NAVAL STATION
Street: ANACOSTIA NAVAL STATION
City: WASHINGTON State: DC Zip: 20374
EPA ID: DC4170000901
Site Description: Contaminants include antimony, chromium, lead, mercury, copper, iron, nickel, zinc, cadmium, silver, cyanide, chloride, paint, manganese. Contaminants could leach into the ground water. Dermal contact must also be avoided.

Site Name: BLADENSBURG ROAD SITE
Street: 1900 BLADENSBURG RD.
City: WASHINGTON State: DC Zip: 20002
EPA ID: DC0001090190

Site Name: CUTHBERT ST. MEDICAL WASTE
Street: 1241 CUTHBERT ST.
City: WASHINGTON State: DC Zip: 20040
EPA ID: DC0001096221

Site Name: DALECARLIA WTP/WASH AQUEDUCT DIV
Street: 5900 MACARTHUR BLVD.
City: WASHINGTON State: DC Zip: 203150220
EPA ID: DC1960000908
Site Description: Congressional correspondence requested the investigation of the alleged dumping of PCB transformer wastes at the facility.

Site Name: FENWICK ROAD TRAILERS
Street: 1800 FENWICK ROAD
City: WASHINGTON State: DC Zip: 20020
EPA ID: DC0000877985

Table 3-10. CERCLIS sites in the District of Columbia. (continued)

Site Name: FOOD AND DRUG ADMINISTRATION
Street: 2ND AND C ST., SW
City: WASHINGTON State: DC Zip: 20204
EPA ID: DC8470000086

Site Name: FORT LINCOLN
Street: BARNEY DR NE
City: WASHINGTON State: DC Zip: 20018
EPA ID: DC9470090003
Site Description: Hazard ranking determined 08/01/82. Site was on interim priority list and removed. OERR claims site in Federal Register as a removed "R" site from the NPL. Site was D then N, now it is R. Until the next change.

Site Name: NATIONAL ARCHIVES & RECORDS ADMIN
Street: 7TH AND PENNA AVE., NW
City: WASHINGTON State: DC Zip: 20408
EPA ID: DC5470000006

Site Name: NPS - ANACOSTIA PARK SECTIONS E & F
Street: 1900 ANACOSTIA DRIVE, S.E.
City: WASHINGTON State: DC Zip: 20020
EPA ID: DCD003254273
Site Description: Site is bordered on the north by the congressional cemetery, on the east by Anacostia river, west by Barney Circle. Land use is restricted to park activities.

Site Name: PEPCO BENNING ROAD FACILITY
Street: 3400 BENNING ROAD NE
City: WASHINGTON State: DC Zip: 20019
EPA ID: DCD983967951

Site Name: SOAP STONE CREEK
Street: 4500 ALBEMARLE ST.
City: WASHINGTON State: DC Zip: 20008
EPA ID: DC0001011766

Site Name: ST ELIZABETH'S HOSPITAL
Street: 2700 MARTIN LUTHER KING AVE
City: WASHINGTON State: DC Zip: 20032
EPA ID: DC9751305997

Site Name: TUXEDO VALET
Street: 1715 7TH STREET N.W.
City: WASHINGTON State: DC Zip: 20004
EPA ID: DCD983967928

Table 3-10. CERCLIS sites in the District of Columbia. (continued)

Site Name: USA FT MCNAIR
Street: 350 P STREET SW
City: WASHINGTON State: DC Zip: 20319
EPA ID: DC8210021004

Site Name: USAF BOLLING AIR FORCE BASE
Street: 5 CAPITAL ST
City: WASHINGTON State: DC Zip: 20331
EPA ID: DC5570024443

Site Name: USDA NATIONAL ARBORETUM
Street: 3501 NEW YORK AVENUE NE
City: WASHINGTON State: DC Zip: 20002
EPA ID: DC7120507432
Site Description: Gravel pit site has potential for releasing hazardous substances to the environment shop area site has potential for accumulation of hazardous substances to exist in surfical soils.

Site Name: USN NAVAL RESEARCH LAB BLDG A-11
Street: 4555 OVERLOOK AVE
City: WASHINGTON State: DC Zip: 20375
EPA ID: DC8170024311

Site Name: USN NAVAL SECURITY STATION
Street: 3801 NEBRASKA AVE., NW
City: WASHINGTON State: DC Zip: 20390
EPA ID: DC1170023476

Site Name: WALTER REED ARMY MEDICAL CENTER
Street: 6825 16TH ST NW
City: WASHINGTON State: DC Zip: 20305-5001
EPA ID: DC4210021156

Site Name: WASHINGTON CHEMICAL MUNITIONS
Street: 50TH AND MASSACHUSETTS
City: WASHINGTON State: DC Zip: 20015
EPA ID: DCD983971136

Table 3-10. CERCLIS sites in the District of Columbia. (continued)

Site Name: WASHINGTON GAS LIGHT SITE
Street: 12TH & M STS, SE
City: WASHINGTON State: DC Zip: 20019
EPA ID: DCD077797793
Site Description: The main part of the site is 11.2 Acres. It was used actively as a coal gasification plant from 1888 to 1948 and sporadically from 1948-85 or 86.

Site Name: WASHINGTON NAVY YARD
Street: WASHINGTON NAVY YARD
City: WASHINGTON State: DC Zip: 20374
EPA ID: DC9170024310

Site Name: INTERNATIONAL TRANSMISSION
Street: 3188 BLADENSBURG ROAD
City: WASHINGTON, D.C. State: DC Zip: 20020
EPA ID: DCD983971011

Source: CERCLIS Data Base Search, March 25, 1996.

A total of 32 CERCLIS sites are listed in DC; however, detailed information was only available on 7 sites (more than the basic information such as the site name and address). This additional information included: the contaminants (no volume or concentration data) present at a site, land use restrictions, and brief site histories. Figure 3-4 presents a map showing the locations of CERCLIS sites in DC. The sites are not ranked because the data search did not reveal enough information about the risks associated with these sites to perform such a task. If a site was listed on the NPL, it would be "scored," using the Hazard Ranking System (HRS), to evaluate its potential risks to human health and the environment. EPA adopted HRS to assess the relative threat associated with actual or potential releases of hazardous substances at sites. Using the HRS, a site is evaluated based on four contaminant migration pathways: (1) ground water; (2) surface water (threats to drinking water, human food sources, and the environment); (3) soil exposure (threats to resident and nearby populations); and (4) air. Three major factors are used to evaluate each pathway: (1) likelihood of release; (2) waste characteristics (toxicity and quantity); and (3) receptor targets (human and ecological components). Based on this scoring, a site may be nominated by EPA for inclusion on the NPL. Recently, the Washington Navy Yard was proposed by EPA for possible inclusion on the NPL. As mentioned above, most of the sites in DC have received only limited investigation, and appropriate information is not available for "ranking." Therefore, sites on this list are presented (Table 3-10) as retrieved from the CERCLIS database. The site names, addresses, and EPA ID numbers are provided for all CERCLIS sites in DC. Some entries also include brief descriptions on the nature of contamination at the site.

3.1.5 TRI Facilities

TRI Releases in DC

- 6 Facilities Reported Releases for 1994
- Total of 23,000 Pounds of Toxics Released in 1994
- Chemicals Released - Copper Compounds, Chlorine, and Glycol Ethers

Six facilities in DC reported releases of toxic chemicals in 1994 under the Toxic Release Inventory (TRI) program (U.S. EPA, 1996; RFF, 1996). While no facilities in DC reported for 1993, six TRI facilities reported total releases in 1994 of more than 23,000 lbs of toxic chemicals. This was the smallest amount released of any "state" in the U.S. Only American Samoa reported lower releases (RFF, 1996). Table 3-11 presents the facilities, type/media of release, and toxic chemicals emitted/released (RFF, 1996). Reporting of releases of toxic chemicals is required under Section 313 of the Emergency Planning and Community Right-to-know Act (EPCRA). TRI's

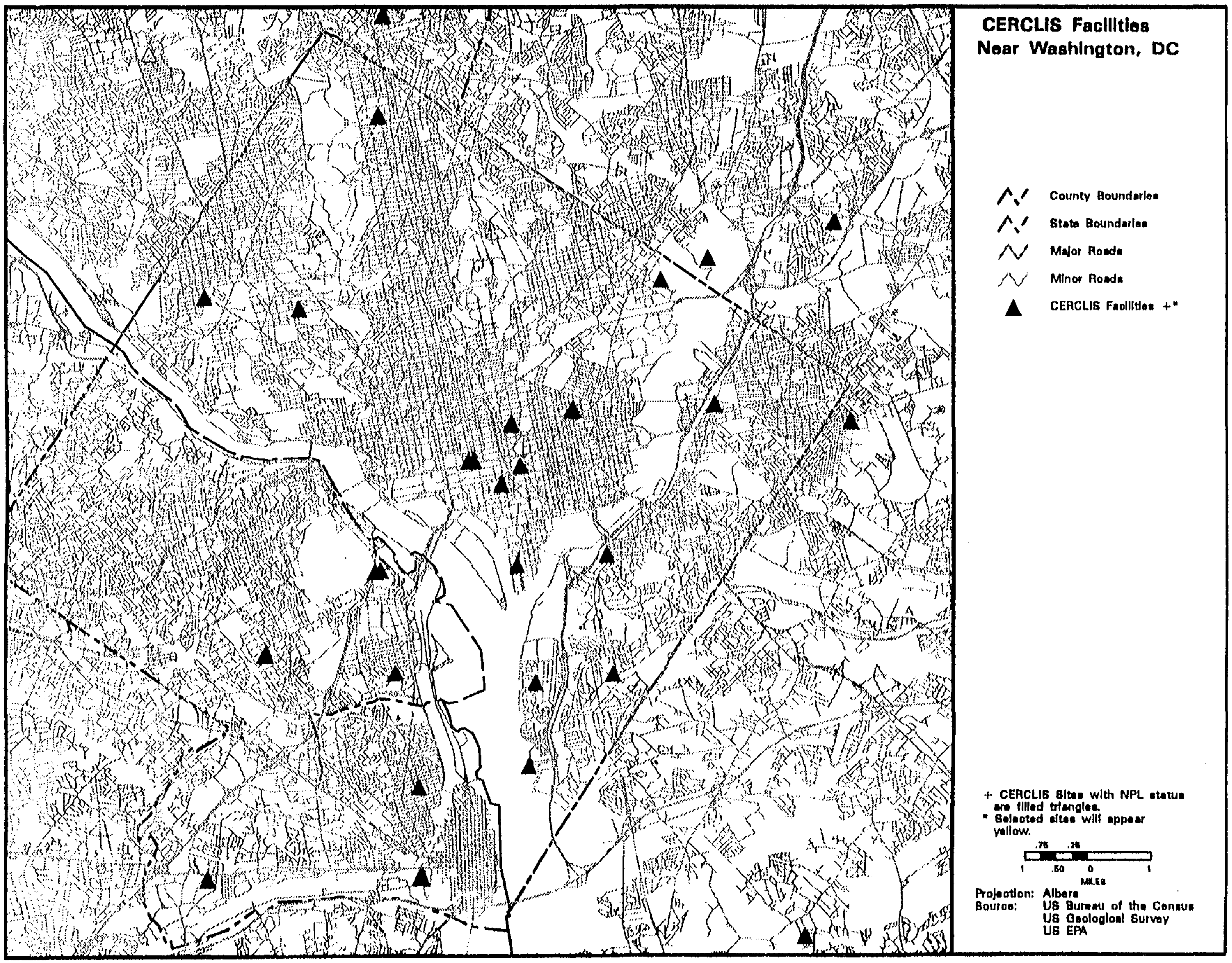

Figure 3-4. Location of CERCLIS sites in the Washington, DC area.

Table 3-11. Toxic chemical releases in DC in 1994.

Facility name	**Toxic chemicals released**
Air Force--Bolling AFB	hydroquinone
Army Corps of Engineers--Dalecarlia WTP Aqueduct	chlorine
Army Corps of Engineers--McMillan WTP Aqueduct	chlorine, copper compounds
Bureau of Engraving	glycol ethers, nickel, sulfuric acid
Capital Printing Ink Co., Inc.	copper compounds, phosphoric acid
Secret Service	lead
Type of TRI releases	**Pounds released**
Releases to Land	17,300
Air Emissions	4,891
Surface Water Discharges	1,600
Underground Injection	0
Total Releases	23,791
Compounds released	**Pounds released**
Copper Compounds	17,300
Chlorine	5,010
Glycol Ethers	1,481
Hydroquinone	0
Lead	0
Total Releases	23,791

Source: RFF, 1996.

purpose is to provide information to the public about toxic chemicals in their communities. Reporting of environmental releases, off-site transfer, treatment, etc. is required if facilities meet the following requirements: (1) they are primarily engaged in manufacturing activities; (2) they have 10 or more full-time employees; and (3) they manufacture or process greater than 25,000 pounds or otherwise use greater than 10,000 pounds of a toxic chemical. The list of toxic chemicals ("The TRI List") that are subject to reporting contains approximately 600 specific chemicals and chemical categories. Such information is submitted to the EPA on the EPA Form R, and is entered into the Toxic Chemical Release Inventory System (TRIS) data base. TRIS contains information about the releases to land, air, and water and off-site transfers of toxic chemicals from the applicable facilities.

3.2 NONPOINT SOURCE POLLUTION IN DC

Nonpoint Source Pollution

- Air - Mobile Sources
- Water - Stormwater Runoff and Combined Sewer Overflow
- Solid Waste - Trash Collection and Illegal Dumps

Most people are familiar with point-source pollution, which comes from wastewater discharge pipes or power plant smokestacks. While this type of pollution is relatively easy to regulate through permits and to control through treatment units, nonpoint source (NPS) pollution, however, cannot be directly attributed to a single source. It comes from stormwater runoff from farm fields, parking lots, and construction sites or other sources such as automobile exhaust. Regulating NPS is far more difficult than point sources, because the pollutants are more diffuse and come from larger areas. In addition to nonpoint source pollution of air and water, solid wastes are of concern. Residential solid waste management has changed over the last few years in DC. In 1995, the city cancelled the curbside recycling program and in 1996, trash collection was cut back to once per week (RFF, 1996). Recently, the recycling program was re-initiated by the city. Illegal dumps are also an area of concern, with more than 200 illegal dumps estimated to exist in DC (RFF, 1996). These dumps can be, at a minimum, an eye sore and affect the aesthetics of a community. Moreover, they can be threats to human health because of bacteria, rodents, or the presence of toxic wastes.

3.2.1 Nonpoint Sources of Air Pollution

Motor vehicles produce much of the air pollution in DC and the region. Within DC, as much as 70% of the ozone precursors are attributable to motor vehicle emissions (RFF, 1996). MWCOG (1996) has estimated that 28% of the VOC emissions for the entire region comes from motor vehicles. Approximately 250,000 motor vehicles are registered in DC and 2.8 million are registered in the metropolitan area (RFF, 1996). Commuting traffic accounts for about one-third of the motor vehicle emissions of VOCs in the metropolitan area and the remainder comes from other uses (MWCOG, 1996). The DC Department of Public Works estimates that each weekday about 800,000 vehicles enter DC (RFF, 1996). In addition to VOC emissions, other air pollutants are released, such as carbon monoxide, lead, and particulates. All of the motor vehicle usage in the DC metropolitan area is estimated to result in the daily emissions of 369 tons of hydrocarbons, 1,693 tons of carbon monoxide, and 161 tons of nitrogen oxides (RFF, 1996).

Nonpoint Source Air Pollution

- Motor Vehicles are Largest Source of Ozone Precursors
- 2.8 Million Motor Vehicles Registered in DC Metro Area

3.2.2 Nonpoint Sources of Water Pollution

Nonpoint surface water pollution comes from stormwater runoff and combined sewer overflow. Pollutants include nitrogen, phosphorus, heavy metals, toxic organic chemicals, petroleum-based oils, and floatable trash. Nonpoint source runoff from DC accounts for 3% of the nitrogen and 16% of the phosphorus in the Potomac River downstream from DC (DCRA, 1994a). Excessive levels of nitrogen and phosphorus are detrimental to rivers, streams and other waterbodies because they promote excess growth of algae. Although algae produce oxygen during the day from photosynthesis, most of that oxygen is used by the algae at night for cell growth. When the algae dies, it settles to the river bottom and decays, using still more oxygen. Low oxygen levels impair fish, oyster, and crab populations, reducing the amount of fish and shellfish available for harvest. In addition, algae overgrowth blocks out sunlight necessary for underwater grasses, which provide food, shelter, and nursery areas for aquatic animals. Heavy metals and organic chemicals build up

Stormwater Runoff Loadings

- 400,000 Pounds of Zinc
- 94,000 Pounds of Copper
- 22,000 Pounds of Lead

in fish and shellfish tissues, resulting in consumption bans. Floatable trash is an eyesore, interfering with enjoyment of our aquatic resources. And petroleum-based oils contaminate our drinking water, making it taste bad. It has been estimated that stormwater runoff from DC in a 10-month period in 1989 provided loadings of 400,000 pounds of zinc, 94,000 pounds of copper, and 22,000 pounds of lead to the streams and rivers (RFF, 1996). This pollution is believed to exceed the discharges of these compounds from Blue Plains Wastewater Treatment Plant (RFF, 1996).

The loadings of pollutants from nonpoint sources also results from combined sewer overflow (CSO). Stormwater runoff, from as much as one-third of the city's area, is drained by a CSO system. During heavy rainstorms, runoff from streets is combined with sewage which flow into the nearest waterbodies (Chesapeake Bay Research Consortium, 1995). When severe rainstorms exceed the capacity of the combined sewers, untreated sewage is released from 60 overflow drains to the city's surface waters (RFF, 1996). This CSO discharge contains bacteria, nitrogen, and other pollutants that are detrimental to ecological health (and indirectly to humans). The Anacostia River receives 63% of the CSO and the balance is absorbed by Rock Creek and the Potomac River (Chesapeake Bay Research Consortium, 1995). As a result, the Anacostia receives higher concentrations of cadmium, zinc, lead, PCBs, chlordane and other pollutants than other water bodies in DC. Perhaps of greatest concern is the bacterial pollution - the Anacostia River's levels of bacteria frequently exceed public health standards following rainfall. The annual volume of combined overflow has been estimated to be 2,400 million gallons, accounting for about 70,000 pounds of nitrogen, 20,000 pounds of phosphorous, and other pollutants to the Potomac and Anacostia rivers (RFF, 1996).

Combined Sewer Overflow (CSO)

- Discharge of Stormwater and Untreated Sewage into Rivers and Streams
- Anacostia River Receives Much of DC’s CSO Discharge
- Bacteria, Nitrogen, Phosphorous Loadings

3.2.2.1 *Reducing Nonpoint Source Pollution to Surface Waters*

How do these pollutants enter the watershed? Unfortunately, NPS pollution comes from a wide variety of small and diverse sources. Nitrogen and phosphorus can result from overuse of fertilizers on farms as well as residential lawns and gardens. These nutrients are also emitted by automobiles and power plants. Recent studies indicate 25% to 35% of the nitrogen that enters the waters of the District come from air pollution from coal-fired power plants in the Midwest. Scientists are conducting additional studies to further evaluate the problem. Maryland and Virginia are reducing airborne pollutants through their vehicle emissions testing programs. Another nonpoint source of nitrogen and phosphorus is animal waste, which ranges from cow manure in agricultural areas to dog droppings left on city streets. Because animal wastes may also contain potentially dangerous bacteria, people should adhere to State and local regulations regarding the animal waste management. Farmers can store and apply manure as fertilizer at appropriate times to ensure rains do not carry it into local streams. Pet owners in the District can clean up after their animals to ensure those wastes do not run into catch basins on streets.

Heavy metals and oils enter waterbodies through runoff from streets, driveways, and parking lots. To reduce these pollutants, car owners should keep their cars tuned, fix fluid leaks, and properly dispose of used motor oil. Many car owners change their own oil. The problem hinges on what they do with the used oil, which is toxic to wildlife and can impair water quality in streams and rivers. In the past, car owners simply dumped the waste oil into the closest storm sewer. We now recognize that this is both improper disposal and wasteful - recycled motor oil has commercial value. Most service stations will accept used oil for recycling. In addition, stenciling programs have been undertaken in the District to remind people that they are living in an area that generates "Chesapeake Bay Drainage." By painting this legend on a storm sewer inlet, people remind car owners and others are reminded that out of sight is not out of mind.

Floatable trash, including foam cups, cigarette butts, plastics, and paper enters the storm sewer system on a daily basis. Many of these materials do not readily biodegrade and, therefore, will remain along the shorelines and in the water for years. Many cities have undertaken programs to manage floatable trash and

Reducing Nonpoint Source Pollution in DC's Rivers

Excess nutrients, sediment and stormwater runoff in DC rivers are killing the fish and causing algae overgrowths.

You can help by:

- Using less fertilizer on your yard. Everyone benefits when lawn care products are used according to the manufacturer's directions. Yard runoff is a major contributor to excess nutrients in the rivers of DC.
- Keeping your car tuned. Much of the excess nitrogen that enters our rivers comes from the tailpipes of the thousands of cars that travel the DC area every day.
- Cleaning up after your animals. It's not just the law.
- Calling the city when you see construction sites that don't manage stormwater runoff or sediment. If there's mud on the street, it's going into the river. Sediment kills fish, aquatic wildlife, and plants, and ruins future use of recreational areas.

debris by placing filter fences across the discharge points of storm sewers. The fencing traps the floatables for recovery and disposal, which preserves the quality and the beauty of the waterways. This does not need to be a government project, however; high schools and neighborhood associations are often active participants in maintaining their streams and rivers. It should also be noted that shopping centers and malls are now protecting their storm sewers against floatable trash and debris by fencing off the inlets and drop boxes with wire to isolate the problem at its source.

While the report on the nonpoint sources of pollution may seem grim, things are not all that bad. The Federal Government owns a majority of the lands that lie directly along the Potomac and Anacostia Rivers. Developed federal lands in Washington, DC generate as much as 300 million gallons of stormwater per year (Chesapeake Bay Research Consortium, 1995). The Federal agencies that are responsible for these lands, which include the National Park Service, the Department of Defense, and the General Services Administration, have made a public commitment to reduce their contribution of pollution by 40% or more. Federal money is being invested to reduce or eliminate sources of pollution and excess stormwater, to control or contain contaminants, and to minimize future impacts on the environment in the District.

On a more personal level, the ban on phosphate-based laundry detergents has helped reduce water pollution. Since these types of detergents were eliminated, phosphate levels (nutrients) have dropped measurably in the waters that receive treated household wastewater, including the DC rivers. Clothes still get clean, and our rivers are now cleaner. Perhaps the best news is the grassroots effort to protect and redevelop the environment of the District of Columbia. Schools, neighborhoods, Scout troops, and senior citizens are actively seeking to improve their quality of life by preserving and enhancing the Potomac and Anacostia Rivers. It is important to each of us who enjoys life in the District to take charge of this piece of the environment.

4. CHARACTERIZATION OF ENVIRONMENTAL RISKS TO HUMAN HEALTH

> **Characterizing Human Health Risks**
>
> - Drinking (Tap) Water
> - Fish Consumption
> - Ambient Air Quality
> - Lead
> - Contaminated Soil

Environmental risks associated with human health come in many forms. **What is an environmental risk?** Environmental risk is anything in the environment that may cause harm or loss if persons come in contact with it. **What are some of these risks?** Risks can be the results of exposure to contaminants in foods we eat; the air we breathe (pollutants in the air from motor vehicles); and/or materials we touch (debris on our land and in our waters). We can also be exposed to pollutants at our places of work and in our homes from products that we buy and use. Some of these risks are the result of not knowing that adverse health problems may be caused by exposure to certain pollutants. Other risks may be caused by intentional actions such as misuse of certain chemicals, or dumping debris or garbage in areas that are not designed for that purpose. **How do these exposures affect us?** When exposed to chemicals or pollutants at levels that are too high, our health may be affected in various ways. We may be affected for short periods of time -- itchy eyes, skin rashes, difficulty in breathing, etc., or we may be affected for a longer period of time with health problems such as cancer, emphysema, kidney or liver disorders. Sometimes these exposures can add to an existing health problem (e.g., air pollutants indoors and outdoors may aggravate respiratory problems such as asthma).

How do we get exposed to pollutants? There are three major routes by which a person may be exposed:

- Inhalation (breathing in pollutants from the air);
- Ingestion (eating or drinking contaminated foods and water); and
- Dermal (pollutants contacting the surface of the skin).

Figure 4-1 presents examples of how exposure may occur through the three exposure routes. It should be noted that the figure does not provide an exhaustive treatment of all exposure examples that could be mentioned. To do so, is beyond the scope of this report. It does however, provide some typical examples of how an individual may be exposed to chemicals/pollutants.

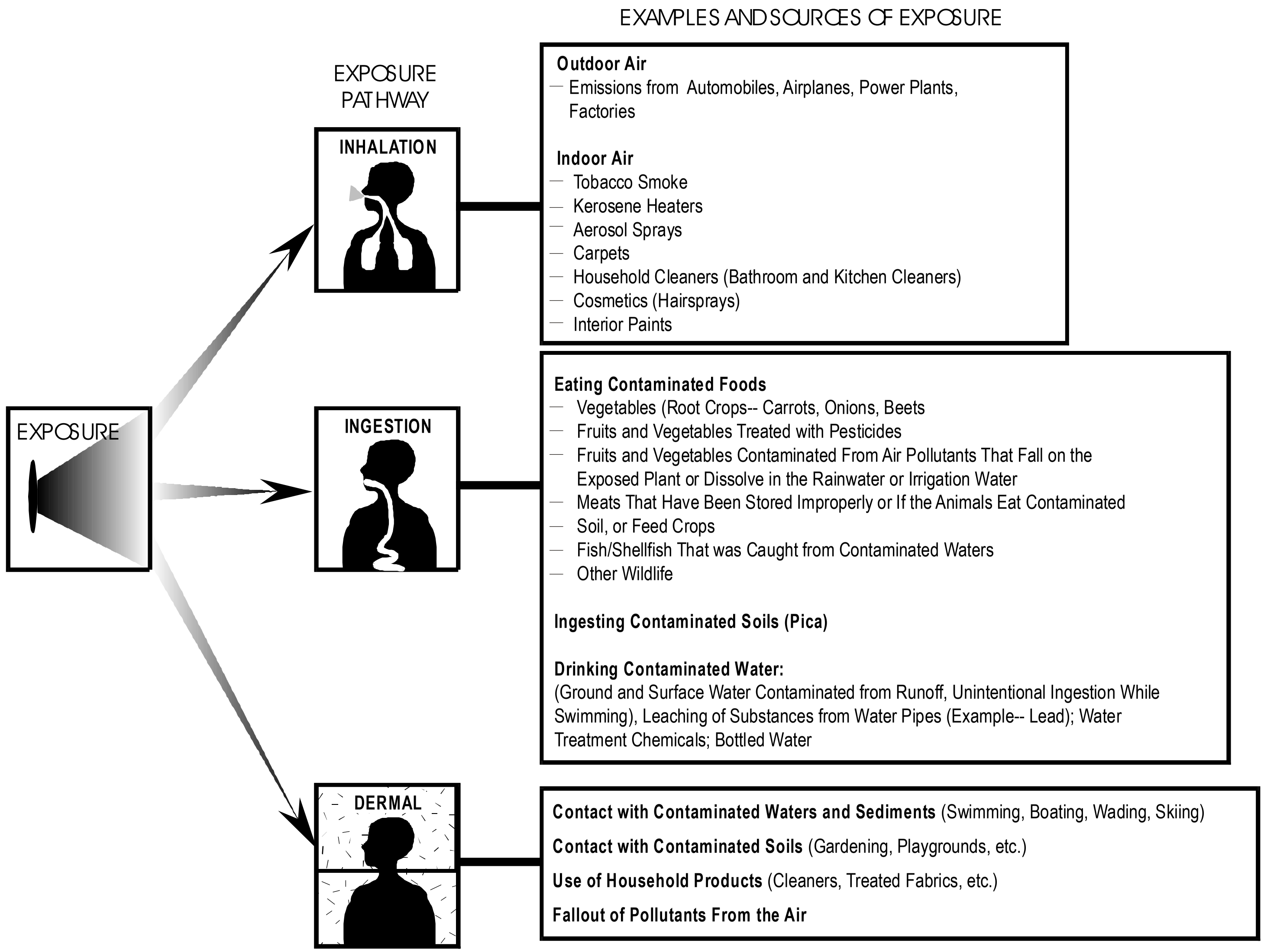

Figure 4-1. Example of how one may be exposed to chemicals/pollutants.

The following subsections describe some major topics that relate to risks to human health from environmental conditions in Washington, DC. These topics (drinking water, fish consumption, ambient air quality, lead, and contaminated soil) are considered to be among the means by which people can be exposed to pollutants; however, this list is by no means comprehensive. Described for each topic in the following subsections are the issues of concern, descriptions of DC's particular circumstances, monitoring programs to determine levels of contaminants, and the potential impacts to human health.

4.1 DRINKING WATER

4.1.1 Overview of Drinking Water Issues

The District's drinking water continues to be of concern, especially following several "boil water" advisories over the last few years. These advisories have been issued because of concerns over disease-causing bacteria/pathogens in drinking water. In addition, these incidents have highlighted the importance of continued improvements to the water treatment, disinfection, and distribution systems serving the DC area. Despite these problems, the drinking water in DC meets regulatory standards and is safe for use by most of the population (U.S. EPA, 1996a). However, individuals who have weakened immune systems should take precautions (consult their physicians and/or boil the water) with respect to use of drinking water (U.S. EPA, 1996a). Tapwater concerns also include chemical contaminants such as metals (especially lead) and trihalomethanes (THMs) that are present in drinking water at levels that may impact human health. The following sections describe the District's drinking water systems, levels of contaminants in drinking water, and the potential for risks to human health.

> "Last week the CDC and EPA announced that tapwater that is safe enough for healthy individuals could be dangerous for immuno-compromised persons. This echoes what advocates for people with AIDS and others have said for some time..."
>
> NY Times, June 22, 1995
> (Wald, 1995)

4.1.2 Drinking Water Supply (Treatment, Problems, and Improvements)

The Potomac River is the source for drinking water in the District. No wells (public or private) exist in DC for use of ground water as a source of drinking water (Baker Environmental, 1993). Bottled water is used as the primary source of drinking water by approximately 37% of the DC population (CDC, 1994). Water is removed from the Potomac River at Great Falls and Little Falls, and is treated at the Dalecarlia and McMillan treatment plants. These plants, operated by the

U.S. Army Corps of Engineers (USACE), filter and disinfect the river water to produce drinking water for all of DC and portions of Northern Virginia (including Arlington and Falls Church). Figure 4-2 presents a map showing the areas served by the drinking water produced by these plants (USACE, 1994a). While the USACE is responsible for the treatment plants, the water is distributed to DC residents by the DC Water and Sewer Authority (WASA). This collaborative effort to supply drinking water, comprised of separate treater and distributor, is unique and complicates the process to upgrade the system and improve water quality.

On December 8, 1993, DC residents were advised to boil tap water when it was used for consumption because of increased turbidity (cloudiness due to small suspended particles) (CDC, 1994). This city-wide boil water advisory was prompted by poor performance of treatment plant filters to prevent the potential for infectious diseases (Olson, 1995). The primary concern during this (and subsequent) episode was the potential for harmful microbial contaminants, such as *Cryptosporidium* or *Giardia*, to cause infections in the population (CDC, 1994). Under normal circumstances, filtration and disinfection using chlorine are effective in killing microbial contaminants. However, with increased turbidity, there was a concern that the treatment plants might not be effective in controlling parasites or microorganisms (Olson, 1995). The city-wide boil water advisory, as well as more recent incidents involving elevated levels of bacteria/turbidity, have illustrated the importance of continuing efforts by the USACE and WASA to upgrade facilities and modify operating procedures (USACE, 1996a; King, 1996). These actions to improve the drinking water quality have also been monitored by the U.S. EPA as part of a Proposed Administrative Order for DC (issued in November 1995). This order addressed the need for improvements with the operation of the distribution system, prompted by violations for bacteria (total coliform) and improper maintenance of the distribution system (U.S. EPA, 1996c).

Specific plants that the USACE and WASA have for improving water quality in DC include:

- USACE - removal of residuals and studies of other disinfection techniques (USACE, 1996a), and

- WASA - increased flushing of the distribution system (water mains, pipes, etc.) and cleaning reservoirs (King, 1996).

4.1.3 Levels of Contaminants in DC Drinking Water

Levels of certain contaminants in DC drinking water may pose risks to human health. Although public water supplies are regulated by EPA under the Safe Drinking Water Act and DC's drinking water complies with standards, contaminants are present in the drinking water. Specifically, the following types of contaminants have been detected in DC's drinking water supply:

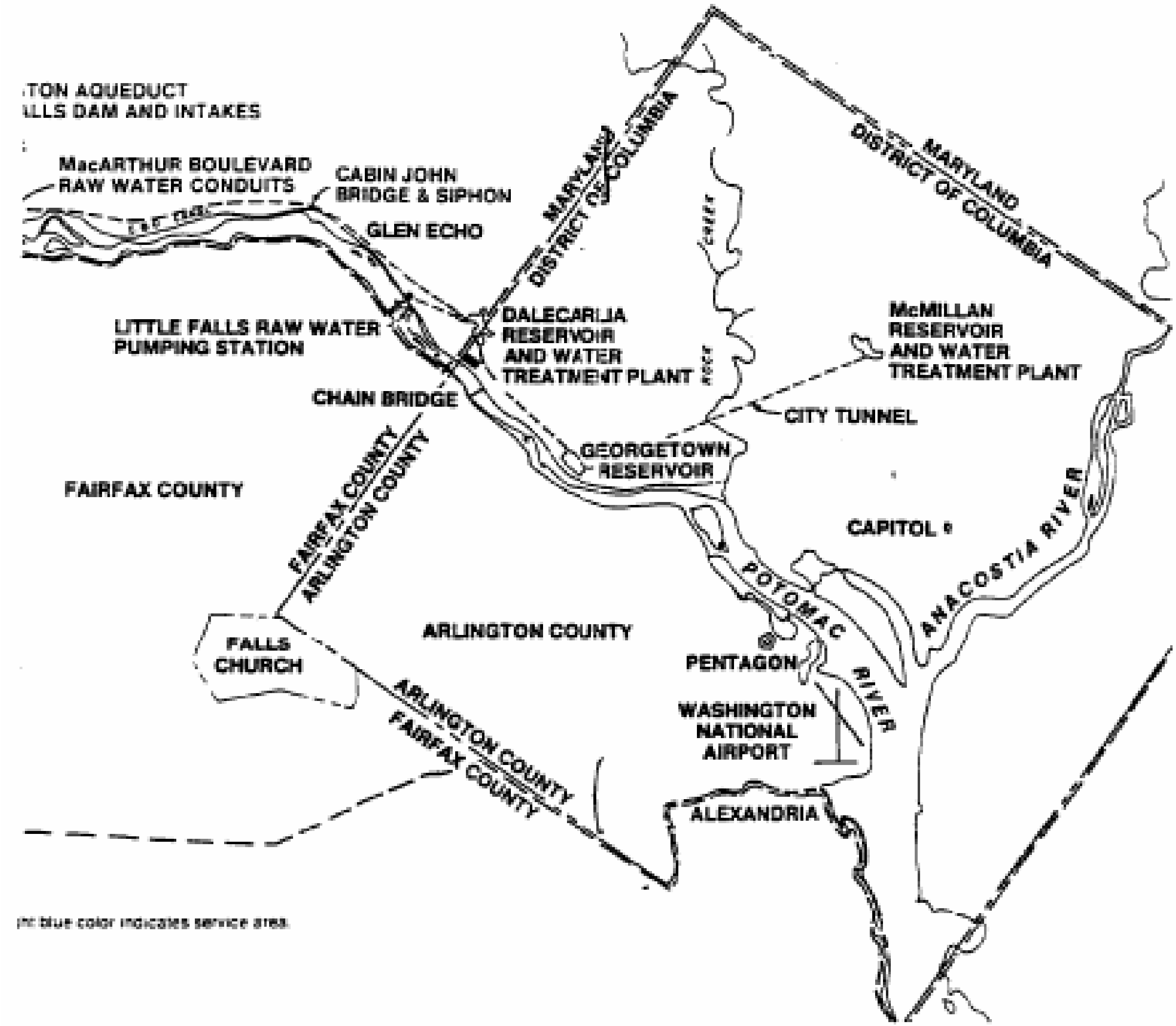

Figure 4-2. Washington Aqueduct - service area and major facilities.

Source: USACE, 1994a.

- Bacteria - coliform (fecal coliform and E. coli);
- Metals - lead (from older pipes and others sources); and
- Trihalomethanes - chloroform and other cancer-causing chemicals that are by-products of disinfection using chlorine.

USACE monitors its treated water and tapwater for various contaminants at 70 locations throughout the city (USACE, 1996b). These monitoring results are reported to EPA to ensure that the drinking water meets standards. Table 4-1 presents a summary of data from the USACE's monitoring of drinking water quality when it leaves USACE's plants (USACE, 1994a). In addition, USACE monitors the untreated water that it removes from the Potomac for potentially-dangerous bacteria and parasites. Recent studies indicate that *Cryptosporidium* may be present in 65 to 97% of surface waters (lakes and rivers) that are tested in the U.S. (CDC, 1995). Specifically, *Cryptosporidium* and *Giardia* have been found in the raw water from the Potomac; however, they have never been found in the treated water distributed for drinking (Olson, 1995).

Lead (and other metals) are of concern, even at low levels (below enforceable limits) because of its toxic effects, especially to children. Of particular concern are lead pipes in older homes and apartment buildings that may cause elevated levels of lead in drinking water. Lead has been found in tapwater samples at levels as high as 68.7 parts per billion (ppb), well above the EPA "action level" of 15 ppb (Olson, 1995). However, USACE data for 1994 show the monthly minimums, averages, and maximum levels of lead in water from the treatment plants were consistently low (below the detection level of 0.02 mg/L) (USACE, 1994a). DC's lead testing program, "terminated" in 1994, will be resumed by WASA in January, 1997 (Cochran, 1996).

Chemical contaminants that may pose risks to human health include the trihalomethanes (THMs). These cancer-causing chemicals are formed in the treatment plants as a by-product of chlorine disinfection. With the increased use of chlorine to disinfect the water (against microorganisms), formation of THMs continues to be of concern (Olson, 1995). Some reports attribute as many as 10,700 cases of cancer per year in the U.S. population to THMs in drinking water (Schwartz, 1996). While the average concentrations of THMs are generally below EPA's standard of 100 ppb, levels of these chemicals occasionally exceed this standard (Olson, 1995). Data from the USACE on treated water from 1994 (Table 4-1) indicate that total THMs were present at concentrations ranging from 20 ppb to 167 ppb (USACE, 1994a). Furthermore, if the limit for THMs is reduced in the future to 80 ppb or 40 ppb (as has been speculated), USACE may consider changing its disinfection from a chlorine-based to either a chloramine or ozone disinfection process. Such a change would be expected to significantly reduce the formation of THMs in drinking water.

Table 4-1. Drinking water treatment plant concentration data for 1994[a].

	Raw Water			Dalecarlia			McMillan			
	Average	Maximum	Minimum	Average	Maximum	Minimum	Average	Maximum	Minimum	MCL[b] (mg/l)
Metals (mg/l)										
Aluminum	0.36	1.16	0.1	0.89	0.149	0.035	0.08	0.129	< 0.02	
Barium	0.044	0.064	0.029	0.051	0.073	0.031	0.046	0.063	0.024	2
Calcium	32	43	20	39	49	28	39	48	28	
Copper	< 0.004	0.009	< 0.002	< 0.004	0.007	< 0.002	0.038	0.141	< 0.002	
Iron	0.56	1.38	0.16	< 0.012	0.013	< 0.01	< 0.012	0.01	< 0.01	
Lead	< 0.002	0.002	< 0.002							0.015[c]
Magnesium	8	10	5	8	11	5	8	11	5	
Manganese	0.054	0.08	0.038	< 0.003	0.006	< 0.002	< 0.002	0.002	< 0.002	
Nickel	< 0.002	0.002	< 0.002				< 0.002	0.002	< 0.002	0.1
Potassium	2.9	4.6	1.9	2.9	4.2	2	2.9	4.2	2	
Sodium	10.7	17.3	4.7	10.3	16	4.9	11.2	20.4	6	
Strontium	0.164	0.267	0.077	0.163	0.258	0.084	0.163	0.26	0.085	
Zinc	0.004	0.012	0.002	0.003	0.014	< 0.002	0.004	0.018	< 0.002	
Lithium	0.003	0.004	0.001	0.002	0.004	< 0.001	0.002	0.004	< 0.001	
Trihalomethanes (ug/l)										
Chloroform	2.3	5.4	0	56.2	115	13.9	61.4	138.4	13.3	0.1
Bromodichloromethane	0.5	1.6	0	13.7	23.1	5.1	14.9	24.8	6.9	0.1
Chlorodibromomethane	0	0.3	0	2	3.2	0.5	2.4	4.2	0.9	0.1
Bromoform				0	0.1	0				0.1
Total Trihalomethanes	2.8	7	0	71	141	20	79	167	22	0.1
Pesticides (ug/l)										
Toxaphene	< 2.9	< 5	< 2.7	< 2.9	< 5	< 2.7	< 2.9	< 5	< 2.7	0.003
Volatile Organic Compounds (ug/l)										
Carbon Tetrachloride				ND	0.5	ND	ND	0.7	ND	0.005
Radionucleids (pCi/l)										
Gross Alpha							1	2	< 1.0	15 pCi/L
Gross Beta				3	4	2	3	5	2	4 mrem
Strontium - 90				0.8	1	0.4	1	2.3	< 0.5	
Polyaromatic Hydrocarbons (ug/l)										
Chrysene							< 0.2	0.2	< 0.2	0.0002
Fluorene							< 0.2	0.2	< 0.2	
Microorganisms (MPN/100m; %)										
Total Coliform	4235	10680	280	1	3.5	0	1.1	4.9	0	
Fecal Coliform	515	1559	127	0.4	1.7	0	0.3	1.9	0	

a - This table summarizes concentrations of contaminants detected in drinking water samples from more detailed data provided by the USACE Washington Aqueduct.

b - MCL is the maximum contaminant limit.

c - Action Level for Lead.

Source : USACE 1994.

4.1.4 Potential Risks to Human Health from Drinking Water

Human health impacts from consumption of drinking water can be considered in both the long- and short-term perspectives. Longer-term risks are evident from the presence of lead and cancer-causing THMs. The shorter-term risks from bacteria, parasites, and other disease-causing organisms may be the most evident human health impacts, especially for susceptible portions of the population. For example, the effects of lead, especially on children, are of concern because of possible brain and nervous system effects. Furthermore, microbial parasites (such as *Cryptosporidium*) are dangerous and potentially fatal to persons with weakened immune systems (such as those with AIDS). Although *Cryptosporidium* has never been identified in DC's drinking water supply, the problems with turbidity in the drinking water continue to raise concerns about its potential presence during periods of high turbidity. This parasite sickened 400,000 and killed more than 100 people in Milwaukee, Wisconsin, in 1993 (CDC, 1994). The Centers for Disease Control (CDC, 1994) reported that the Milwaukee incident occurred when turbidity levels were much lower (peak of 1.7 NTU) than those observed in the DC drinking water during the boil water advisory (peak of 9.0 NTU). However, public health surveys conducted by the CDC (1994) in 1993 following the DC boil water advisory found no major increase in diarrhea or other related illnesses. Turbidity levels in samples analyzed for 1994, ranging from 0.07 to 0.60 NTU (USACE, 1996), were below concentrations when diseases (*Cryptosporidiosis*) have occurred (0.9 to 2.0 NTU), according to the Centers for Disease Control (CDC, 1994). An extra measure of monitoring to protect human health from *Cryptosporidium* was recently ordered by the EPA (U.S. EPA, 1996d). EPA ordered approximately 300 large metropolitan water systems, including DC's, to test for *Cryptosporidium* and other disease-causing microbial contaminants.

4.2 FISH CONSUMPTION

4.2.1 Overview of Fish Consumption Issues

Contaminated fish and shell fish are potential sources of human exposure to toxic chemicals (as are other foods - see Section 4.4.2). Pollutants are carried in the surface waters, but also may be stored and accumulated in the sediments of streams. Consequently, finfish and shellfish exposed to these pollutants may be consumed by humans. Human exposures to chemical contaminants through fish consumption depend on the amount of fish consumed and the concentration of contaminants in the fish tissue. In general, contamination is highest in catfish, eel, and carp caught from DC waters.

To evaluate risks to human health as a result of eating contaminated fish or shellfish, knowing fish consumption rates is important. Fish consumption rates may vary for specific subpopulations. Because many surface water bodies and, in particular, freshwater bodies are not commercially fished, consumption of fish from water is basically limited to fish caught by recreational anglers. Although these anglers may represent a small fraction of the total population living in the vicinity of a contaminated body of water, they may be representative of the majority of risks posed by consumption of fish from the contaminated surface waters. Some recreational anglers may fish from contaminated sites for sport and not consume the fish, but other (subsistence) anglers may be obtaining a large portion of their diet from contaminated sites because they cannot afford to purchase other foods (U.S. EPA, 1992). Therefore, these anglers may be dependent on the fish from the local waters for food. Unfortunately, the fish species upon which they depend may be the species (eel, carp, catfish) that have the highest levels of contaminants (Velinsky and Cummins, 1994). Examples of such contaminants are PCBs and pesticides. Other compounds of concern are heavy metals such as mercury (from natural sources).

The results of various surveys have indicted a significant portion of the District residents consume the fish from DC waters (DCRA, 1994b). DC currently has fishing advisories in effect because of levels of elevated levels of PCBs and chlordane detected in fish. A public health advisory was issued in 1989 for the consumption of channel catfish, eel, and carp caught in the city stretches of the Potomac and Anacostia Rivers (DCRA, 1994b). The advisory limited the consumption of these specific fish to 1/2 pound per week.

In addition, a public health advisory that replaced the 1989 version, was issued in 1994 for all DC water as follows (DC, 1994):

- "DO NOT EAT: catfish, carp, or eel;
- MAY EAT: 1/2 pound per month of largemouth bass, OR 1/2 pound per week of sunfish or other fish;
- CHOOSE TO EAT: younger and smaller fish of legal size; and
- THE PRACTICE OF CATCH-AND-RELEASE IS ENCOURAGED."

The advisory recommendations do not apply to fish sold in markets, grocery stores, and restaurants because the sources for this fish is different. The advisory also recommended that the fish, if eaten, be prepared and cooked in a manner to reduce the fat content as follows:

- Always skin the fish and trim away the fat;
- Always cook fish so that the fat drains away from the meat (i.e., baking, grilling, broiling);
- AVOID pan frying or making soups and chowders; and
- For poaching and panfrying, discard the broth or oil.

4.2.2 Levels of Contaminants in Fish in DC Waters

Fish may be exposed to and uptake the chemicals from the water, sediment, or food; therefore, these chemicals may accumulate in the fish tissue. Certain chemicals accumulate in specific parts of the fish such as the fatty tissues, liver, and bone. If the fish that we eat are contaminated, we are also exposed to the chemicals, thereby, potentially impacting our health.

The District of Columbia Environmental Regulatory Administration, in concert with the Interstate Commission on the Potomac River Basin (ICPRB), monitored selected chemicals in fish tissue from the Anacostia and Potomac Rivers (Velinsky and Cummins, 1994). The objective of the study was to determine the concentration and distribution of 129 priority pollutants in fish from the DC waters (Velinsky and Cummins, 1994). According to Velinsky and Cummins, this study represents a part of DC's efforts to evaluate chemical contaminants as they relate to human health concerns and aquatic resources. Samples were collected in 1989, 1991, and 1992. Of the 129 chemicals monitored, 50 were detected in one or more of the species collected (Velinsky and Cummins, 1994). Examples of chemicals detected are PCBs, DDTs, arsenic, mercury, and selenium. Concentrations of many of the organics such as PCBs were greatest in the American eel and channel catfish. Results of the study indicated that detectable levels of many chemicals were present in the edible portions of certain species (Velinsky and Cummins, 1994). A brief overview of levels of contaminants in fish tissue found in Velinsky and Cummins (1994) are presented below.

<u>Trace Metals</u>

Arsenic, selenium, and mercury were the three metals detected in most samples analyzed for all sampling years. In 1991, the highest concentration of mercury and selenium were found in the largemouth bass composite sample from the upper Potomac River. A single composite sample of largemouth bass from the lower Anacostia River had the highest concentration of total arsenic. Chromium, lead, beryllium, and nickel were detected in at least one sample.

In 1992, levels were also detected for chromium in two composite samples, and other metals were detected once or were below the detection limit. The highest concentration of selenium was found in common carp from the upper Anacostia River. The highest mercury concentration was found in a sample of largemouth bass from the lower Potomac River.

Volatile and Semivolatile Organics

Similar volatile and semivolatile organics were detected in the majority of samples collected in 1989, 1991, and 1992. Examples are benzene, 1,1,1-trichloroethane, and polycyclic aromatic hydrocarbons (PAHs). In most samples, the concentrations were low. The authors noted that there is a great amount of handling of samples in the laboratory and some of the chemicals detected are routinely used in the laboratory. Therefore, there is a possibility of some laboratory contamination.

Organochlorine Pesticides

Pesticides were detected in samples for years 1989, 1991, and 1992. Examples of pesticides detected are chlordane, DDT, and dieldrin. In 1991, the highest concentrations of total chlordane and DDT were found in channel catfish and American eel in the lower Anacostia River. In 1992, the highest concentration of total chlordane was found in the American eel from the upper Anacostia River. Other species with elevated levels were the largemouth bass and the common carp.

Polychlorinated Biphenyls (PCBs), Dioxins, and Furans

Total PCBs, dioxins, and furans and selected congeners were analyzed for the study (Velinsky and Cummins, 1994). Various congeners of dioxins and furans were detected, but at low levels (Velinsky and Cummins, 1994). PCBs were detected in most samples; in 1989, PCBs (total) were found in all samples of brown bullhead collected in the lower Potomac and the Anacostia Rivers. In 1991 and 1992, the highest concentrations of most chemicals were found in the American eel, channel catfish, and brown bullhead. The highest concentrations of PCBs were found in American eel samples from the lower Anacostia and the Potomac Rivers. In 1992, the highest concentrations of PCBs were found in samples of the American eel and largemouth bass from the Anacostia and upper Potomac Rivers.

4.2.3 Fish Consumption Patterns in the District of Columbia

Fishing licenses were sold to 12,916 anglers in DC in 1993; of these, 7,613 were DC residents (DCRA, 1994b). In 1994, DCRA conducted the "1994 Recreational Fishing Surveys" for both the shoreline and boat anglers. EPA summer interns from Virginia State University (VSU) also conducted a small creel survey in 1994 along the Anacostia riverbanks. All data presented in this section were obtained from the DCRA (1994c) survey and the VSU (1994) survey.

4.2.3.1 *DCRA Survey*

The DCRA (1994c) survey was designed to obtain data for use of the DC waters and for demographic information including gender, race, age, and residency. Additionally, the survey captured information on catch and harvest. The survey period was March through November, 1994.

Shoreline Angler Survey

According to survey results, shoreline anglers target their catch to a variety of species such as catfish, eel, carp, bass, and perch, and harvest over 86% of their catch. Six sites along the Potomac and Anacostia Rivers were surveyed:

- Fletcher's Boat House,
- Rock Creek/Roosevelt Island,
- Washington Ship Channel/Tidal Basin,
- Hains Point,
- Anacostia Park, and
- PEPCO/Roaches Run/Lady Bird Johnson Park.

Surveys were conducted 4 days per month (2 weekday and 2 weekend), from 7 a.m.-11 a.m.; 11 a.m.-3 p.m.; and 3 p.m.-7 p.m. A total of 110 anglers were interviewed (105 males; 5 females). Racial composition was the following:

- Black 85%
- White 7%
- Hispanic 4%
- Asian 2%
- Indian (East) 1%
- Armenian 1%

The anglers surveyed resided in DC (65%), Maryland (25%) and Virginia (10%). DC residents were stratified as follows: 39% from Northwest, 34% from Southeast, 25% from Northeast, and 1% from Southwest.

Most (78%) of the anglers eat the fish they catch; 8% give them away; 4% release them; and 10% release them and/or give them away. Carp, eel, and catfish caught in DC waters were eaten by 65% of the anglers. The favorite fishing spots were Hains Point, Anacostia Park, and Fletcher's Boathouse, respectively, and the typical shoreline angler was a Black male.

Boat Angler Survey

Boat anglers usually target bass as their fish of choice, and approximately 100% of the anglers release their catch. The boat angler survey was conducted through (postage paid) mailer questionnaires. The questionnaires were distributed to anglers along the Potomac and Anacostia Rivers access points, the C & O Canal boat launch, and to anglers in the open waters. The sample period was June to November. Questionnaires distributed in September and those distributed at the C & O canal were not returned; therefore, the estimates for the boat angler survey may not be entirely representative. The racial composition of the boat anglers was predominantly Caucasian, male, and most resided in Virginia (43%).

4.2.3.2 *Virginia State University (VSU) Survey*

In the study conducted by VSU (1994), of the anglers interviewed, 52% ate 1-3 fish weekly; 16% ate 4-6 fish weekly; 6% ate 7-9 fish weekly; and 6% ate 10 or more fish weekly. However, quantitative exposure cannot be determined because the weight of these fish was not reported. It should be noted that 78% of the survey subjects were unaware of the fish advisory and 58% fished for food. The specie most consumed was catfish (60%), followed by bass (14.0%), and carp (8.0%)/year. The annual household income for most (70%) of the anglers was $15,000 and under.

The VSU survey (1994) was conducted along the banks of the Anacostia River beginning at Buzzard Point and ending at the railroad bridge crossing at Anacostia Park. Racial composition of the anglers was African American (68%); Hispanic (8%); Native American (2.0%); Asian American (10%); and other (12%). The total number of anglers surveyed was not reported.

4.2.4 Potential Risks from Fish Consumption

Results of both surveys indicate that shoreline anglers target (prefer) carp, eel, and catfish -- the species to which the fishing advisories apply. Additionally, most (78%) eat their catch (DCRA, 1994c), and 78% (VSU, 1994) were not aware of a fish advisory. Levels of many chemicals (approximately 50) were detected in samples of fish from DC waters (Velinsky and Cummins, 1994). Velinsky and Cummins specifically investigated the concentration of chemicals in fish from the Potomac and Anacostia Rivers. Metals, pesticides, and PCBs were detected in the samples. Velinsky and Cummins (1994) have reported a high fat content for fish tissues from both rivers for the species preferred by the anglers (carp, eel, catfish). PCBs and pesticides tend to accumulate in fat of organisms. The anglers are exposed to pesticides, PCBs, and other organic and inorganic chemicals as a result of eating contaminated fish that they prefer and are, thus, potentially at risk.

Estimating quantitative risk is difficult, because data on the amount of fish consumed by the angler fishing in the DC waters were not available. In addition, fish consumption patterns differ by race, age, gender, and whether the angler is a recreational sport angler or a subsistence angler. The consumption rate for subsistence anglers tends to be larger than for the recreational angler (EPA, 1995). EPA in its "Draft Exposure Factors Handbook" recommends a mean intake rate of 7 g/day and an upper percentile value of 25 g/day for recreational freshwater anglers for purposes of estimating exposure (U.S. EPA, 1996a). The recommended mean value for the subsistence population is 59 g/day, and the upper percentile value is 170 g/day (U.S. EPA, 1996a). The value for the subsistence population is based on the Native American population. It should be noted that the Exposure Factors Handbook is in draft format and these values could change prior to final publication. However, these values may be used with caveats to conservatively estimate exposure/risk for the shoreline angler population, because site-specific intake data are not available.

Velinsky and Cummins (1994) performed a risk assessment for PCBs, chlordane, and dieldrin. These chemicals were chosen because of the historical concern for their presence in fish tissue in the DC area. A summary of levels for these chemicals from 1989, 1991, and 1992 is presented in Table 4-2. Human health effects estimates were based on U.S. Food and Drug Administration (FDA) "action levels," toxic equivalents for PCBs and dioxins, and a risk model. Although FDA "action levels" are useful benchmarks for identifying concentrations of contaminants that may be at levels of concern, they are actually applicable only for seafood sold through interstate commerce, and are used to remove seafood from the marketplace (Velinsky and Cummins, 1994). For noncommercial fish, they provide guidance for regulatory actions but are not regulatory standards (Velinsky and Cummins, 1994). Therefore, these action levels cannot be used to quantify risk, but are useful for "screening" concentrations found in the samples. The risk assessment was provided in a report of Velinsky and Cummins as a screening tool to assess the potential health effects from levels of contamination in fish from the DC waters. Caveats for the assessment noted by the authors are best described in Velinsky and Cummins (1994).

Carcinogenic risks were estimated for PCBs, chlordane, and dieldrin. The estimates are based on cancer potency factors, reference doses, and fish ingestion rates reported by EPA and a risk model (Velinsky and Cummins, 1994). Two different fish ingestion rates were used: 6.5 grams of fish/day (for the general populace) and 140 grams fish/day (for the subsistence fishermen and the high end of the sport fishermen's potential consumption). Potential risks based on these variables are presented in Table 4-3. These data indicate that PCBs are at levels of concern for human consumption of fish in DC waters (Velinsky and Cummins, 1994). To better estimate the risks involved, site-specific consumption data are needed.

The 1994 Public Health Advisory for DC targeted specific groups of the population at highest risk for adverse effects from eating contaminated fish on a regular basis. They are:

Table 4-2. Levels of PCBs, dieldrin, and chlordane found in tissues of fish from DC waters

Contaminant	Sampling Years											
	1989				1991				1992			
	N	Min.	Max.	Med.	N	Min.	Max.	Med.	N	Min.	Max.	Med.
Dieldrin (ng/g)	3[a]	<0.5	6.9	<0.5	19	<0.5	42	4.0	14	<0.5	37	4.2
γChlordane (ng/g)	3	<7	78	47	19	<1.0	84	14	14	<1	90	10
αChlordane (ng/g)	3	20	340	71	19	2.0	150	37	14	2.0	200	26
PCBs (pg/g)	3	180	1300	330	19	80	2600	620	14	40	1200	470

[a] One species.
[b] All sample concentrations based on wet weight

Source: Velinsky and Cummins, 1994.

Table 4-3. Estimates of potential upper-bound carcinogenic risk from wild fish tissue samples collected in the District of Columbia.

	Chlordane[a]	Dieldrin	Total PCBs[b]
Ingestion Rate - 6.5 g fish/day			
Maximum	5.0×10^{-5}	6.2×10^{-5}	1.9×10^{-3}
Minimum	2.4×10^{-7}	7.4×10^{-7}	2.9×10^{-5}
Median	5.8×10^{-6}	5.9×10^{-6}	3.7×10^{-4}
Mean	9.0×10^{-6}	1.2×10^{-5}	4.8×10^{-4}
Standard Deviation	1.1×10^{-5}	1.5×10^{-5}	4.7×10^{-4}
Ingestion Rate - 140 g fish/day			
Maximum	1.1×10^{-3}	1.3×10^{-3}	3.9×10^{-2}
Minimum	5.2×10^{-6}	1.6×10^{-5}	6.2×10^{-4}
Median	1.2×10^{-4}	1.3×10^{4}	8.0×10^{-3}
Mean	1.9×10^{-4}	2.6×10^{-4}	1.0×10^{-2}
Standard Deviation	2.3×10^{-4}	3.2×10^{-4}	9.9×10^{-3}

[a] 19 of 36 composite samples exceeded potential cancer risk of 10^{-4} at ingestion rate of 140 g/day.

[b] 27 of 36 composite samples exceeded potential cancer risk of 10^{-4} at ingestion rate of 6.5 g/day and all for 140 g/day.

Source: Velinsky and Cummins, 1994.

- Pregnant women;
- Women who are breastfeeding;
- Women who expect to bear children; and
- Children under 15 years old.

In summary, the above-mentioned population targeted by the advisory and the shoreline recreational and subsistence anglers are the populations believed to be at highest risk. Additionally, eel, carp, and catfish seem to pose the highest risk because (1) angler preference for eating, (2) their fat content, and (3) their uptake of PCBs, pesticides, and metals.

4.3 AMBIENT AIR QUALITY

4.3.1 Overview of Air Quality Issues

While descriptions of sources of air pollution (both point and nonpoint) were provided in Section 3, ambient air quality is an indicator to what levels of air pollutants residents might actually be exposed. The air quality in the District is generally good, with some improvement shown during the last few decades. The lack of heavy industry in the DC area partially accounts for the relatively clean air. Levels of pollutants are consistently below the National Ambient Air Quality Standards (NAAQS), which were established to be protective of human health and the environment. The air pollutants monitored include carbon monoxide, nitrogen dioxide, sulfur dioxide, ozone, particulate matter, and lead. While levels of these pollutants in ambient air are typically low in DC (and surrounding areas), certain weather conditions contribute to short episodes where ozone (summertime) and carbon monoxide (fall/winter) may be present at unhealthy levels in the DC area (DC ARMD, 1996). Furthermore, while the ambient (outdoor) air quality in DC is good, limited information about indoor air quality raises concerns about potential impacts to human health.

The following subsections describe the air quality monitoring efforts in DC (and the surrounding metropolitan area), levels of pollutants found in ambient air, the potential for indoor air quality to contribute to human risks, and the potential for poor air quality to affect susceptible populations (older persons, people with asthma, the infirm, etc.)

4.3.2 Ambient Air Quality Monitoring in the DC Area

Air quality is monitored in DC by DCRA's - Air Resource Management Division (DC ARMD), which currently operates a network of seven stations throughout the city. Table 4-4

Table 4-4. **Ambient air quality monitoring stations in the District of Columbia.**

Site name	Address	Pollutants monitored	Monitoring objective
Takoma School	Piney Branch Road & Dahlia Street, NW	NO_2, Ozone	High Concentration
West End Library	24th. & L Street, NW	SO_2, CO, NO_2, Ozone, Particulates (PM-10)	Population
C & P Telephone	2055 L Street, NW	CO	High Concentration
Property Division	2235 Shannon Place, SE	Pb	High Concentration
River Terrace School	34th. and Dix St., NE	CO, NO_2, SO_2, Ozone, Particulates (PM-10)	High Concentration
McMillian Reservoir	Bryant St., NE	Ozone and VOC's	Photochemical Assessment
Chevy Chase Library	Connecticut Ave. & Northampton St., NW	Particulates (PM-10), Pb	Population

Source: DC ARMD, 1996.

presents information on these monitoring stations including their locations, pollutants monitored, and the type of local environment those locations are expected to represent. Locations for these monitoring stations were selected either because they represent areas of high population density or because they are expected to detect high concentrations of pollutants (near to point sources, high traffic areas, etc.). The Metropolitan Washington Council of Governments (MWCOG) coordinates air quality reporting in the DC metropolitan area from a monitoring network of 17 stations throughout the metropolitan area: DC (4 stations), Maryland (5 stations), and Virginia (8 stations). The "air quality index" (AQI) for the DC metro area that is reported in the newspapers, on television, and on the telephone weather line, is computed by MWCOG based on ozone measurements from these 17 stations (MWCOG, 1996).

4.3.3 Ambient Levels of Air Pollutants

Levels of air pollutants in the District are generally well below the national standards and have improved over the last few decades (MWLOG, 1996; DC ARMD, 1996). Air quality monitoring data are available for the last 25 years, partially as a result of the 1977 Amendments to the Clean Air Act and because of improvements/ standardization of monitoring techniques. Summaries of these data for the criteria pollutants of concern are presented in this subsection. Because of periodic exceedances of national standards, the District is classified as a nonattainment area for ozone and carbon monoxide (DC ARMD, 1996). Summarized in Table 4-5 are the air pollutants of concern (their potential sources and human health effects), levels of the five criteria air pollutants, and trends information over the last 25 years for selected pollutants. Figures 4-3 and 4-4 display trends in levels of ozone and lead, respectively, from the early 1980s to the early 1990s. In general, levels of these pollutants have decreased during the last few decades, especially lead whose levels have dropped dramatically since the phase-out of leaded gasoline. Ozone levels also show improvement with fewer days during which levels exceed the national standard (0.120 ppm).

4.3.4 Indoor Air Pollutants

Levels of pollutants can be higher in indoor environments (homes, offices, etc.) than in ambient air. Because most people spend 90% of their time indoors (U.S. EPA, 1988), it is evident that indoor air pollution has the potential to be a major impact on human health. Harmful indoor air pollutants include tobacco smoke, carbon monoxide, bacteria, radon, formaldehyde, and many others. While much emphasis has been placed on reducing radon, tobacco smoke, and other indoor air pollutants from homes and workplaces, site-specific problems still exist.

Limited data exist on levels of air pollutants in indoor environments in the DC area. However, one study discusses levels of carbon monoxide (CO) in indoor air with respect to

Table 4-5. Levels of pollutants in ambient Air in Washington, DC.

Pollutant	Description (Source/Effects)	Current levels[a]	Trends
Carbon Monoxide (CO)	An invisible, odorless product of incomplete combustion of fuel (such as automobiles). Inhalation of CO can impair vision, alertness, and other mental/physical capabilities.	Below standards for most of year (maximum 8-hr. average concentrations ranging from approximately 5.6-8.3 during 1992-93). Higher levels in fall and winter occasionally exceed standards of 9 ppm (8-hr. average) and 35 ppm (1-hr. average).	Decreased by 35% from 1980-1993 (as determined by average second highest maximum). Number of exceedances of 8-hour student decreased from 19 in 1980 to 0 in 1991.
Nitrogen Dioxide (NO_2)	Product of combustion (automobiles, power plants). Nitrogen oxides can contribute to respiratory illness and lung damage in humans.	Levels are approximately 0.027 ppm, 53% of the annual average standard of 0.053 ppm.	Decreased by 20% between 1983 and 1991.
Sulfur Dioxide (SO_2)	Product of combustion, primarily by power generating facilities. Contributes to respiratory tract problems, including lung damage.	Levels are approximately 0.11 ppm, 28% of the annual standard of 0.03 ppm.	Decreased by 32% between 1980-1993.
Ozone	The area's primary air pollution problem. Ozone is formed in the atmosphere from volatile organic compounds (gasoline, paints) in the presence of heat and sunlight. Ozone causes respiratory tract problems, eye irritation, and reduced lung function.	Washington, DC, is a nonattainment area for ozone. Ozone levels of ozone are highly variable and are highest in the summer. Exceedances of the standards frequently occur in the afternoons during hot, sunny days. In 1992 and 1993, no exceedances of the standard of 0.120 ppm occured in DC.	Trends in ozone are highly variable because of the influence of weather conditions. However, in 1980, the standard was exceeded 13 times, while in 1991, only 1 exceedance was recorded.
Particulate Matter (TSP or PM-10)	Particulates in air such as dust, smoke, and aerosols are generated from a variety of industrial facilities and other sources. Health effects include long-term respiratory diseases and eye irritation.	Levels of particulates are generally low, with current levels (annual average concentration of 24-25 $\mu g/m^3$) 49% of the annual standard (50 $\mu g/m^3$) and approximately 20% of the 24-hour standard.	Levels of particulates fluctuated between 1980-1987, with a slight net decrease of 17%. Sampling methods changed in 1988, with no trends evident since that time.

Table 4-5. Levels of pollutants in ambient Air in Washington, DC. (Continued)

Pollutant	Description (Source/Effects)	Current levels[a]	Trends
Lead (Pb)	Lead is a metal that presents serious health threats. Lead can cause irreversible brain, kidney, and nervous system damage. Historically, much of the lead found in ambient air comes from automobiles using leaded gasoline and lead smelters/battery plants. With the phase-out of leaded gasoline in the '70s and '80s, lead levels have dropped dramatically.	Lead levels in DC air average 0.04 $\mu g/m^3$, well below the national standard of 1.5 $\mu g/m^3$.	Levels of lead in ambient air have dropped dramatically in the last 20 years. Current levels are approximately 90% lower today than in the early '80s.

[a] Current levels are generally represented by monitoring data from 1992 and 1993.

Source: DC ARMD, 1996.

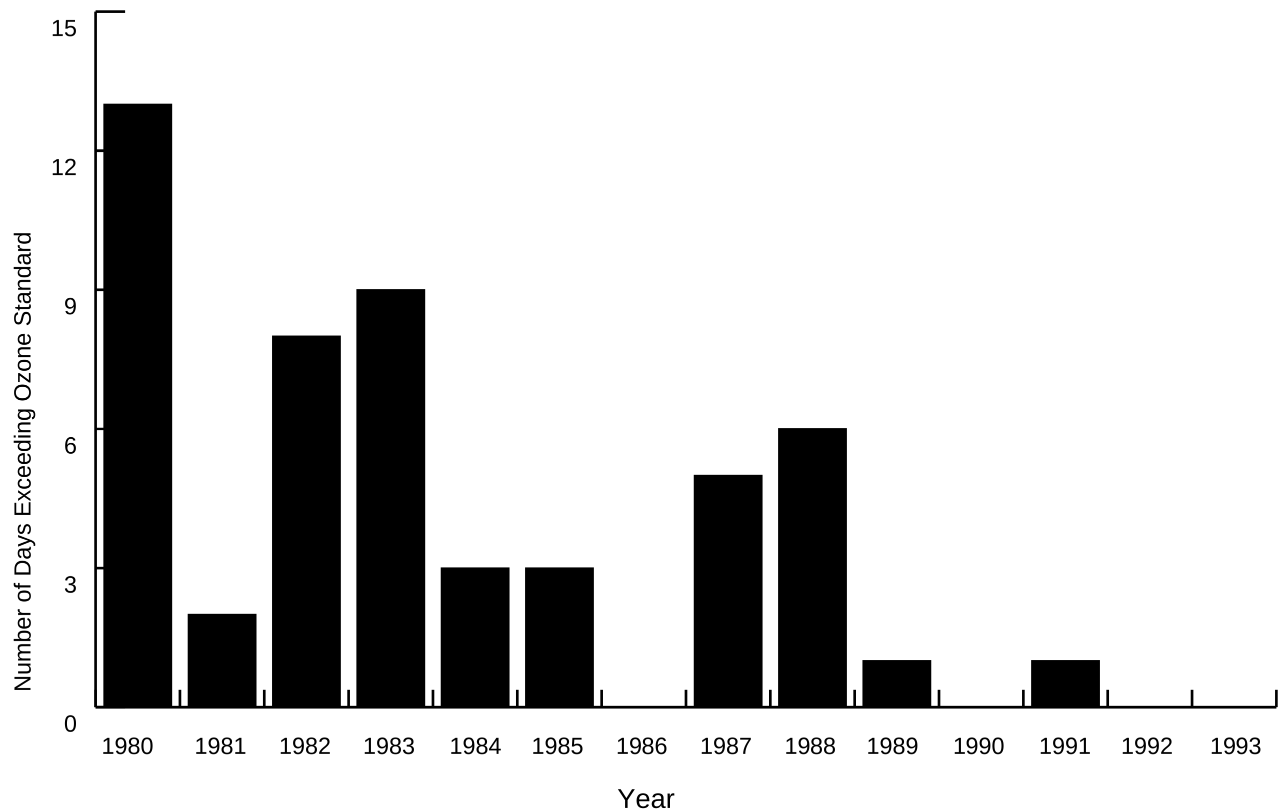

Figure 4-3. Days exceeding ozone standard in Washington, DC (1980-1993).

Source: DC ARMD, 1996.

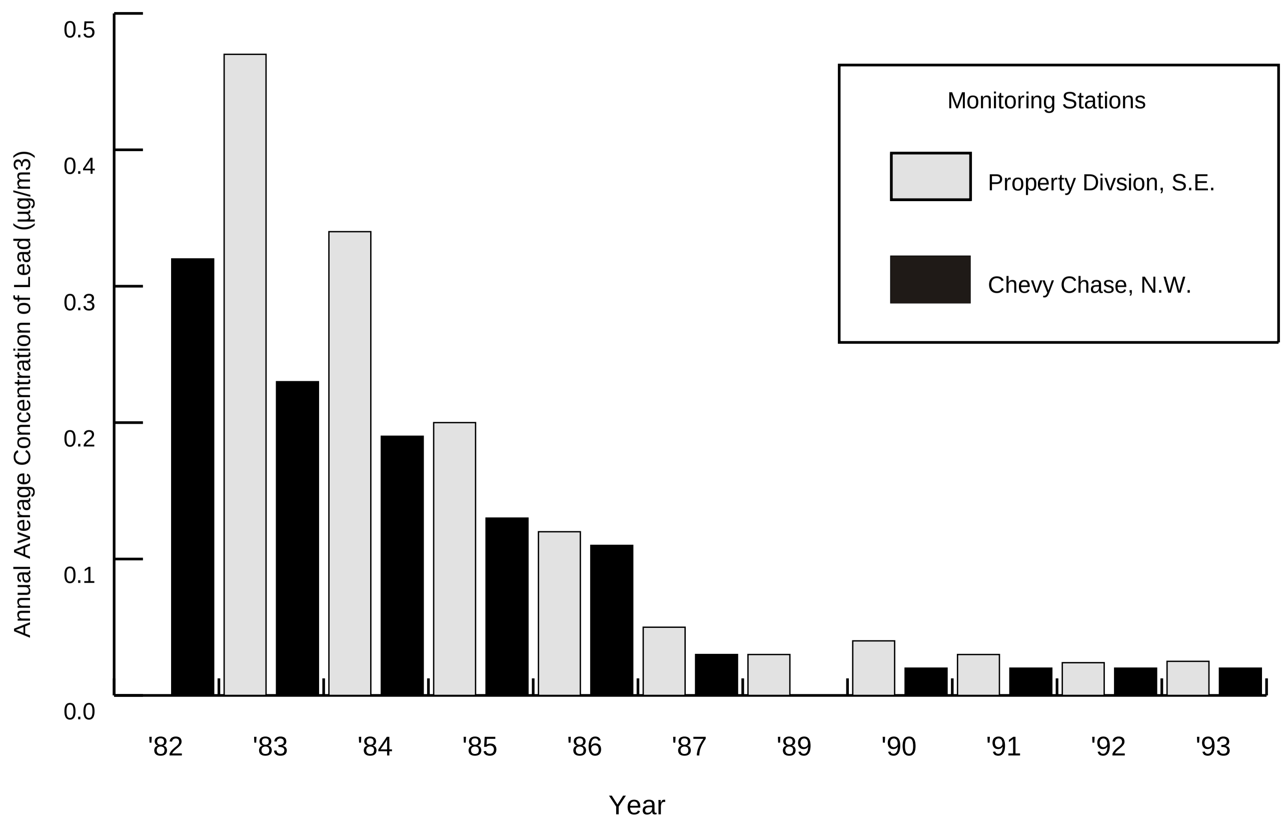

Figure 4-4. Decrease in lead levels in DC ambient air (1982Ñ1993).

Source: DC ARMD, 1996.

residential location in the Washington, DC Standard Metropolitan Statistical Area (SMSA) (Schwab, 1990). In-home CO levels were measured, and results indicated that individuals living in the SMSA center (DC) are exposed to higher levels of CO than are those living in the suburbs. Schwab (1990) reported that CO levels appear to be greater in indoor air in the eastern section of the District than in the northwestern section. Shown below are average concentrations of CO in indoor air for the approximately 700 individuals who were tested in the DC SMSA:

- Northeast, 2.6 ppm CO;
- Southeast; 1.9 ppm CO; and
- Northwest, 1.3 ppm CO.

Possible factors affecting indoor CO levels were briefly described by Schwab (1990). These factors include: traffic flow, gas stoves, and smokers in the residence. It was determined that the general distributions of traffic congestion, smokers, and gas stove use do not adequately explain the spatial variations that were observed.

4.3.5 Potential Health Impacts from Air Pollution

Overall, the air quality in the DC metropolitan area is good. The Natural Resources Defense Council recently evaluated air quality data between 1982 and 1989, and determined that the District ranked 198 out of 237 cities with respect to risk of deaths attributable to air quality (Lee, 1996). However, many health effects have been associated with exposure to air pollution. Persons most at risk for health effects are those with pulmonary (lung) diseases, such as asthma or emphysema. However, thousands of otherwise healthy people may experience effects when concentrations of pollutants (such as ozone) are high, or if they are extremely sensitive to certain contaminants. MWCOG (1996) has identified the following groups in the DC metropolitan area as especially high risk:

- Any of the estimated 210,000 residents of the area who have serious, permanent, or chronic lung disease, such as bronchitis or emphysema.
- Children under the age of 13. It is estimated that 736,400 children live in the DC metropolitan region.

- Anyone with asthma. It is estimated that 225,700 asthmatics reside in the DC metropolitan area, including 53,200 children and 108,500 adults.

- Any of the 336,000 residents over the age of 65.

Health effects vary for each contaminant of concern (See Table 4-5), but it is rare to find a single air pollutant by itself; most pollutants are mixtures. Ozone is the primary air pollutant of concern in the area, causing most of the air quality alerts in the District. During an air quality alert, people at risk should remain indoors as much as possible, preferably in an air conditioned environment. Anyone, regardless of their health status, should avoid heavy exertion from running, bicycling, lawn mowing, and similar activities. Table 4-5 summarizes health effects associated with various air pollutants.

4.4 HUMAN EXPOSURE: LEVELS OF CONTAMINANTS IN "OTHER" ENVIRONMENTAL MEDIA

Examination of the concentration of contamination in various environmental media can reveal the potential for human exposure and resulting health effects. Levels of contamination in media to which we might come in contact (soil, dust, etc.) can be analyzed to determine if adverse affects would be expected. In addition, studies of the levels of chemical contaminants in the human body (blood, urine, fat tissue) can reveal the degree to which chemical exposures have already occurred. If levels of contaminants are too high (lead for example), health impacts may have already been observed. As a result of the severe toxic properties (especially on children where lead affects the nervous system and the ability to learn), blood-lead monitoring programs have been established nationwide.

4.4.1 Lead in Human Blood in DC

Lead has been found in the environment in large quantities over a long period of time. Sources of lead exposure are shown in Figure 4-5. In the 1970s Federal legislative efforts were undertaken to reduce hazards resulting from lead. Limiting the use of lead in paint and gasoline was included in these actions. From 1976 to 1991, the three major sources of lead exposure for the general population were lead in paint, gasoline, and soldered cans (Pirkle et al., 1994). Lead has also been found in other media such as soil and dust. Lead in blood is primarily contributed from gasoline (various ways) and soldered cans (canned foods and soft drinks)(Pirkle et al., 1994). Lead-based paint remains a problem, especially in older, deteriorating houses. National Housing Survey data indicate that in 1989, 20.8-million occupied homes were built before 1940 when lead-based paint was commonly used (Pirkle et al., 1994). This is a decrease from a previous survey;

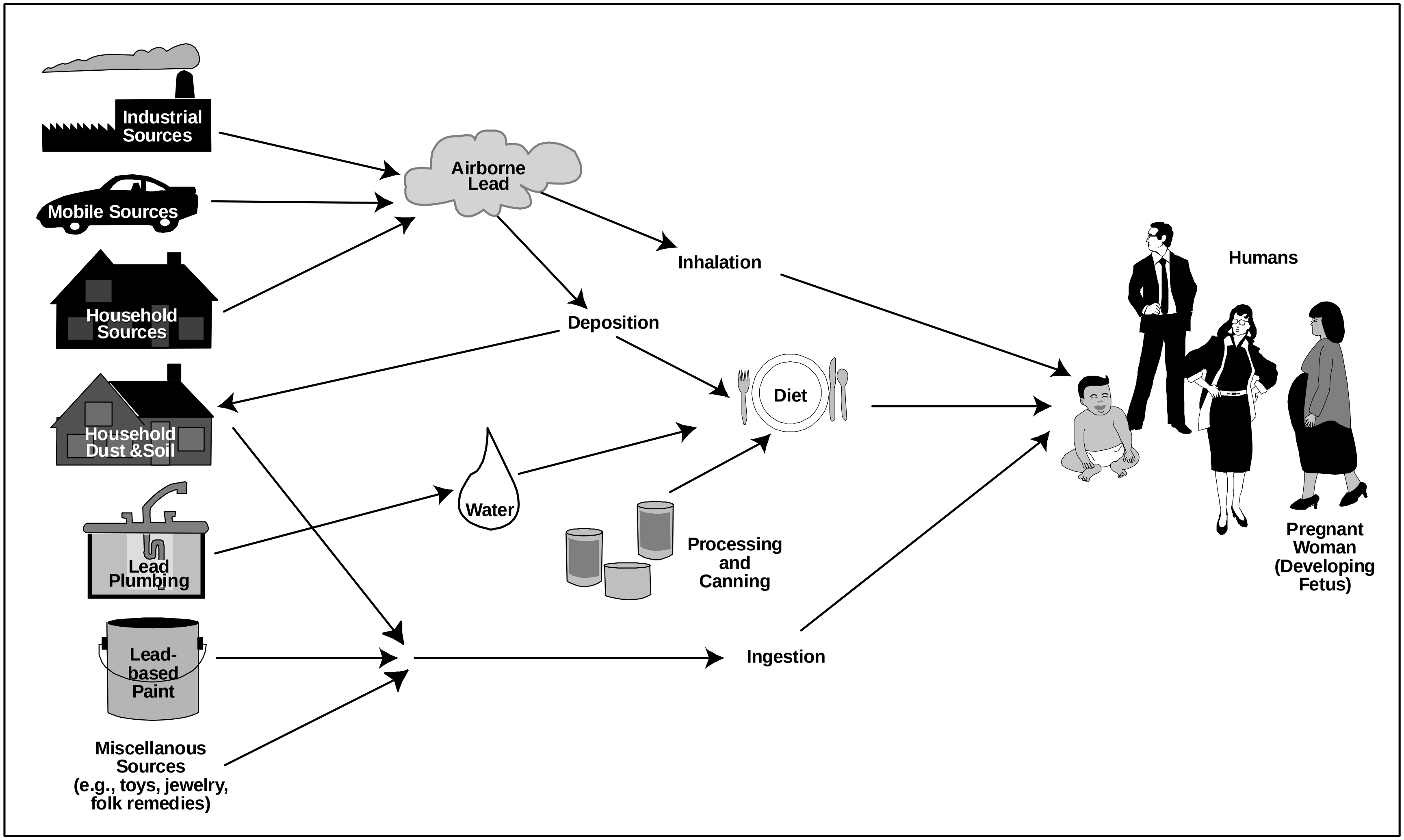

Figure 4-5. Example of how one may be exposed to lead.

however, there is a continuing deterioration of lead-based paint in existing homes. Therefore, these residents in older homes would be exposed to the lead-based paint used in previous years and become a high risk population. Other remaining sources of exposure are lead in dust and soil where the levels have already accumulated, usually from past uses of lead in paint and gasoline (Pirkle et al., 1994). Additionally, drinking water is a source of lead exposure. Lead has been used in service lines; solder for the pipes, fixtures, and fittings; and in the lining in drinking water coolers. Information indicates that DC still has some lead in service lines.

The intentional ingestion of soil called "pica" is another source of lead exposure; however, it is practiced by a small number of people (mostly children). Pica is the term used to define deliberate human ingestion of non-food items, such as soil, paint chips, or plaster. A number of studies have been conducted to measure the amount of soil ingested by children. Calabrese, et al., (1989) estimated that soil ingestion for children ranged from 29 to 40 mg/day; pica children may consume 10 or more grams of soil per day.

Results from a national survey have shown a decrease in blood lead in the United States general population and in certain subgroups in the last 10 years (Pirkle et al., 1994). Much of this decrease can be attributed to the phase out of lead in gasoline, which has substantially lowered levels of lead found in ambient air (EPA, 1988). However, certain sociodemographics continue to be associated with higher blood lead levels. They include children, males, non-Hispanic Black race/ethnicity, and low income level (Pirkle et. al ,1994). The Centers for Disease Control (CDC) lowered the acceptable blood lead concentrations in young children from $\leq$25 to $\leq$10 μg/dL (Rafia et al., 1993). Rafia et al. examined lead poisoning in children aged 9 months to 3 years in three geographic areas. The areas were inner city (Washington, DC); suburban (Silver Spring, Maryland); and rural (Charlottesville, Virginia; Waldorf and Clinton, Maryland). Blood specimens were obtained form 4,196 children as part of routine physical examinations in DC. The clinical population consisted of 95% African-American, 7% Hispanic, and 3% Oriental or White. In the suburban sample of 212 children; 206 were White, 4 were African-American, and 2 were Orientals. The rural sample consisted of 120 children; racial make-up was not provided in Rafia et al. (1993).

Mean blood levels by geographic location are shown in Table 4-6. The blood lead levels for the inner-city children are higher than levels for the suburban and rural children. The levels presented in Table 4-6 for the inner-city children are based on 1,000 children. However, 780 (18.6%) of the 4,196 inner-city children studied had levels $\geq$10 μg/dL which is the CDC acceptable level (Rafia et al., 1993). In contrast, only five (2.4%) of the suburban and seven (5.8%) of the rural children had levels $\geq$10 μg/dL. Also, 71 (1.6%) of the inner-city children had blood lead levels $\geq$25 μg/dL. In contrast, none of the children from the suburban and rural groups had blood lead levels

Table 4-6. Mean lead concentrations in inner-city, suburban, and rural children.

Community	Number of specimens	Blood lead concentration[a]
Inner-city	1,000	10.4 ± 8.0
Suburban	212	4.2 ± 1.79
Rural - Charlottsville, VA	120	4.3 ± 2.58

[a] Values presented as mean ± SD in μg/dL.

Source: Rafia et al., 1993.

$\geq$15 μg/dL. Mean blood levels groupings for the inner-city children are shown in Table 4-7, these indicate that 82% of the subjects from the inner-city were within the CDC acceptable range.

The authors acknowledge that the average blood lead levels in American children as a whole have declined. However, Rafia et al. (1993) report that "these data reflect an overall incidence in the general population without reference to factors such as geographical areas, racial make-up, and socioeconomic status." This study results indicate that in inner-city children, the mean blood lead levels are 60% higher than for children of similar ages, but from different geographic locations (Rafia, et al., 1993). In addition, 85%of the children in the inner-city group had Medicaid or no medical insurance, and all patients from the suburban group had medical insurance (Rafia, et al., 1993). Therefore, Rafia et al. concluded that socioeconomic status may be another risk factor for the inner-city children.

The District of Columbia Lead Poisoning Prevention Program (DCLPPP) performs blood lead level screening yearly. The DC blood lead screening data for years 1993-1995 have been provided by Ms. Ella Witherspoon of DCLPPP. These data are presented in Table 4-8. The target children are ages 6 months through 6 years. Table 4-8 shows that the majority of the children are within the CDC acceptable blood level range for children for all years presented. Unfortunately, the data are not computerized and could not be presented by geographical location within the city, nor by age, race, or sex. These types of data will be available in the future for further analyses (Personal communication with Ms. Witherspoon, DCLPPP, on April 30, 1996).

4.4.2 Contaminants in Soil and Garden-grown Vegetables

Soil may be contaminated with various pollutants from various sources such as pesticide application, waste dumping, and pollutants fallout from the air. Examples of how persons can be exposed to pollutants in the soil through are:

- Foods grown in the soil (root crops such as carrots, beets, potatoes);
- Meats and dairy products (animals eat contaminated soil and feed crops grown in the soil);
- Soil contact to the body (participating in outdoor recreation such as playing in parks, gardening, or occupational exposure such as construction (roads or building)); and
- Unintentional ingestion of soil and intentional ingestion of soil (Pica).

Preer et al., (1980) measured heavy metals in garden soil and in leafy vegetables grown in home and community gardens DC. The major sources of metals in the gardens are believed to be

Table 4-7. Inner-city subjects grouped by blood lead concentration.

Blood lead groups (μg/dL)	Number of specimens	Blood lead concentration[a] (μg/dL)
<10	3,437	4.7 ± 1.90
10-14	504	11.5 ± 1.4
15-19	144	16.6 ± 1.4
20-24	61	21.7 ± 1.4
25-29	25	27.0 ± 1.4
30-34	13	31.6 ± 1.3
35-39	12	36.9 ± 1.3
≥40	21	58.8 ± 16.2

[a] Results are expressed as mean ± SD.

Source: Rafia et al., 1993.

Table 4-8. Screening results: number of subjects per blood lead level grouping.

Blood lead levels	1993 (% of Total)	1994 (% of Total)	1995 (% of Total)
0 - 9 ug/dL	25,164 (90.93)	30,284 (92.4)	27,793 (92.12
10 - 14 ug/dL	1,726 (6.37)	1.960 (5.97)	1,789 (5.9)
15 - 19 ug/dL	463 (21.67)	315 (.96)	326 (1.0)
20 - 44 ug/dL	301 (1.08)	212 (0.6)	241 (0.8)
45 - 69 ug/dL	20 (0.072)	17 (0.05)	18 (0.05)
Greater than 70 ug/dL	0 (0)	1 (0.003)	5 (0.01)
TOTAL SCREENED	27,674	32,789	30,172

Source: District of Columbia Lead Poisoning Prevention Program (DCLPPP), 1996.

lead paint, sewage sludge, and automobile exhaust (Preer et al., 1980). The levels of metals in soil and leafy vegetables are shown in Table 4-9. Of the metals measured in soil, lead was the most frequently elevated. Twenty-six gardens had greater than 100 ppm lead. Results from soils in 70 gardens gave a mean value of 200 ppm of lead. This level was on the lower end of the range of values when compared with soil levels in other major cities (Preer et al., 1980). Levels for lead ranged from 6-1410 ppm. Of the 70 gardens sampled, 18 gardens were within 0-2 miles of center city, 21 were within 2-4 miles, and 31 gardens within 4-6 miles. A decrease in soil lead was observed with distance from center city (Preer, et al., 1980).

A mean of 4.5 ppm lead was found in leafy vegetables from 38 gardens in DC; however, this value is lower than those for other major cities. Preer et al. attributed this factor to improved analytical techniques, and time of year samples were collected. The results of the other city were based on sample collection in the fall when the metal levels are higher; District samples were collected in the summer using plants that generally have less uptake (collards). Preer et al. also found elevated cadmium levels in garden soil with low soil pH or elevated levels of cadmium in the soil. The overall conclusions of Preer et al. were: lead in soil decreased with distance from center city; lead in leafy vegetables increased with soil lead; and cadmium in leafy vegetables increased with decreasing soil pH.

Table 4-9. Metals in soil and leafy vegetables - DC garden survey.

	Soil			Leafy vegetables		
	Range	Mean	Median	Range	Mean	Median
Pb	6 - 1410	200	61	1 - 12	4.5	3.8
Cd	.05 - 3.7	.62	.40	.13 - 9.1	1.3	.72
Zn	20 - 1200	160	98	35 - 470	140	99
Cu	3 - 140	37	29	3.6 - 19	8.6	8.2
pH	3.7 - 8.0	6.2	6.0			

Source: Preer et al., 1980.